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THE ELECTRIC LIGHTING ACT.

WE doubt very much if those who have so long been agitating for a change in the law relating to electric lighting will cry content with the amended Bill of Lord Houghton which the "Secret Commission" of the House of Lords has just recommended to Parliament. In another column we publish the full text of the Bill, together with a brief sketch of its history. It will be seen that the most important clause is that which gives the Board of Trade power to vary the conditions of purchase upon which local authorities can, under the 27th section of the existing Act, acquire an electric light undertaking. In the original Bill brought forward by Lord Houghton, the section giving the local authorities power at the end of twenty-one years to purchase compulsorily at the price of the material only, and without any addition by way of compensation or for goodwill, remained intact. Various suggestions have been made for the amendment of this provision, many persons seeming to suppose that an extension of the period at which the local authority might step in would meet the case. The longer the undertakers are allowed to work without interruption, the more favourable, of course, will be their prospects of success; but to our mind the very principle of compulsory acquisition upon such terms is wrong, and the electric lighting companies and firms should not stop until they have obtained something more definite than the discretionary power granted to the Board of Trade by the terms of the amended Bill. According to our reading of the added clause, the Board of Trade will only exercise its power in cases where the undertakers and the local authority have already agreed as to conditions; and we can scarcely conceive the latter, with the right of acquisition open to it, voluntarily surrendering that right in order to meet the views of the undertakers. Until it does surrender its right and agree to a compromise, the Board of Trade, according to our view, has no power to interfere; and thus what is put forward as a valuable peace-offering turns to ashes in the mouth of the recipient. The solution of the difficulty has not yet been reached, and the work of Lord Thurlow's committee is still far from complete.

An engineering contemporary which formerly was amongst the foremost in opposing the Electric Lighting Act, and in contending that it retarded the industry it was meant to assist, has recently shown a complete and remarkable change of front, concluding at length that the success or failure of the electric light in the future turns not on legislation but on cost. Speaking of the failures which have taken place and the companies which have been wrecked, our contemporary says: "It is easy to say that their arrangements were not perfect and that money was wasted. All that is quite true. But if money had not been wasted and the arrangements had been as perfect as possible, the result would have been the same." Now, eighteen months or more ago we had something to say upon this question of amending the Electric Lighting Act, and the words we then wrote will perhaps bear repetition now, for they are not one whit less applicable, and will also serve to show that in 1884 we arrived at the conclusion which the *Engineer* has only just reached. On November 29th, 1884, we said: "We have never been amongst those who contended that the Electric Lighting Act was responsible for the whole, or even more than a small portion, of the disaster which has overtaken the greater number of electric lighting companies. Had the Act never come into existence at all, the probability is that all those companies which have passed into liquidation would have been in precisely the same condition ere this, involving, though, a greater amount of loss." One month later, December 29th, we wrote: "Before insisting so strongly that a modification of the Electric Lighting Act would remedy the whole of the evil and lead to a general use of the light, we would advise contractors to assure themselves that the thing is possible at the present moment under legislation of the most favourable kind. That amendment or repeal of the [27th] clause would leave them with much greater freedom to push the industry to greater possibilities of success we admit and contend; but we deprecate the attempt to lay the whole of the blame for the present state of things upon the Electric Lighting Act."

This was our view in 1884, and we endorse every word we then wrote. Leaving the Electric Lighting Act altogether out of consideration, there remains a very great deal for the electrical engineer to do before electric lighting can be said to be a complete practical and financial success. How the nearest possible approach to perfection is to be reached is for those who are actually engaged in the work to ascertain; but that success will ultimately attend their efforts we are convinced. Our contemporary to whose remarks we have already alluded, takes a much less hopeful view, and lays it down as incontrovertible that electricity cannot compete with gas in cost, and that unless it can be made so to compete it cannot be made to pay. We do not agree with this, nor with the further statement that the only chance of reduction in cost which electricity has lies in its extended adoption. Extensive use is no doubt a very desirable element; but the principal sources of reduction in cost of electricity will, we imagine, be the reduction in the cost of motive power and a still greater economy in incandescent lamps. Meanwhile, the public are gradually becoming educated to a desire for "more light," and a remunerative business is even now being done in supplying the wants of those who are willing to pay a larger sum than they have been accustomed to pay for gas, in order that they may have a better and a purer light.

COMPARATIVE STUDY OF THE PERFORMANCE OF THE RING ARMATURES OF DYNAMO MACHINES.

THE effectual length of wire of the wrapping of the armature in dynamo machines, states F. Uppenborn in *Centralblatt für Elecktrotechnik*, has been for a long time the subject of manifold speculations and trials, more or less to the purpose. We will, in the first place, bring forward certain opinions on this subject and discuss them afterwards.

As regards the armatures of dynamos a distinction is frequently made between efficient and inefficient wire. Efficient wire is that which is carried between the polar surfaces of the magnets and of the ring, and inefficient wire is that which undergoes no inductive action. According to the common view the proportion of the length of induced wire to the total length of wire should be as great as possible. An electrotechnical fabie has, further, invested the non-induced wire with especial vices ; it is said to possess a very remarkable power of developing heat which does not pertain to the induced wires. Both these wires are very widely extended and the former is still uncontested whilst the latter, though still advocated, sways only a limited number of adherents. In the following we shall refute the first opinion. The second is scarcely in need of refutation.

The actions of magnetic force ensue, as is well known, in the form of closed curves. Hereby they are distinguished from the actions of electrostatic force which are otherwise analogous in many respects. The magnetic curves are known as lines of force, or induction curves. These lines of force owe their existence to a power or form of energy which may be known as the magneto-motive power, just as the current lines owe their existence to an electromotive force.

If we continue the comparison we find that in the magnet the polar intensity corresponds to that which in the source of a current is the tension at the terminals. The circumstance that in a prismatic bar magnet the lines of force issue not only at the end surfaces but also at the lateral boundary planes is explained by the fact that the bar magnet is surrounded on all sides with a fairly good conducting medium, the ether, which is in general not the case with sources of currents. The intensity of the poles decreases the more the better the external closing, in so far as such closing is continuous and commences directly at the polar surfaces. Nevertheless in this case the number of the lines of force of the magnetic circuit increases. The above conditions would occur in practice if the poles are connected by a piece of iron of a suitable shape.

The result is different if a small interval is left between the poles and the external iron conduction ; in this case not only the number of the lines of force but the polar intensity will increase. This is the arrangement in ordinary dynamo machines. The ring in such machines is wrapped with wires in such a direction that the wires are cut as far as possible at right angles by the lines of force issuing from the poles. In the arrangement now most prevalent, where the copper coiling forms the interval between the polar surfaces of the electro-magnets and those of the ring, the wrapping must be carried at right angles to the direction of movement of the wires. In such a dynamo with only two poles the same process of induction occurs in both halves of the ring. Both halves of the wrapping are introduced parallel, so that both the current intensities, though not the electromotive forces, are added together. The electromotive force of the ring is the greater the greater the number of the lines of force which enter it from the poles or which take the converse direction. We may put $E = c\,m$, c being a constant and m denoting the number of the lines of force. E will also be proportional to the number of intersections which the conductor undergoes from the lines of force during a certain movement. In an ordinary two-pole machine we may then assume with certainty that any given spiral must have intersected all the lines of force when the ring is turned round 180°.

The electromotive force depends, therefore, on the number of coils which are carried past a pole of the machine in a unit of time. If we take *e.g.* the semi-revolution of a two-pole machine, E will be proportional to half the number of coils. The coincidence is, however, only accidental and can easily give rise to misunderstandings if we apply the same considerations to multipolar machines. If we take a ring exposed to the action of two poles, and therefore halved, and resolve it into four parts by means of two additional poles, we might be readily inclined to assume that since each of the four parts now possesses only half as many coils as did each of the halves previously, the electromotive force of each part is only half as great as formerly ; this, however, is a deception. The number of coils which move past one pole of the machine in a given time is not affected by the application of two additional poles. The electromotive force, therefore, remains the same. It is no small advantage of the multipolar machines that by their means it is possible, at the same speed and with the same heating of the ring to obtain a double or a manifold effect. This

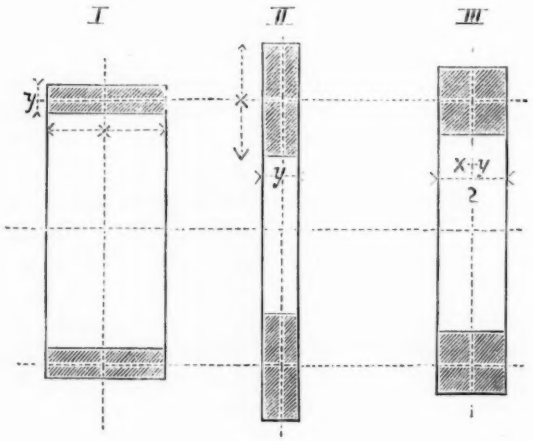


FIG.1.

increased utilisation of a ring has, of course, a limit which cannot be exceeded without other sources of loss compensating, or even outweighing, the advantage aimed at.

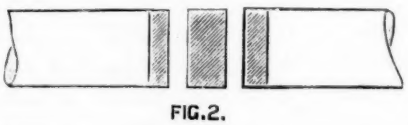


FIG.2.

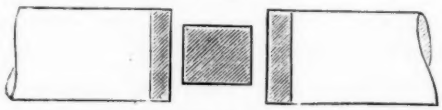


FIG.3.

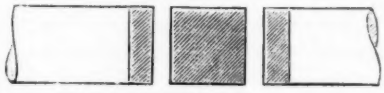


FIG.4.

If the mean speed of the bobbins, length of wire and number of coils remain the same, that ring will naturally be preferable which developes the greatest electromotive force. But the number of lines of force, as we have already seen, increases with the mass of iron in the ring. Hence the preference must belong

to that shape of ring which permits the application of a maximum of iron.

Let us apply this to the construction of ring armatures. In fig. 1 I. represents a cylindrical ring, II. a flat ring, and III. a square ring. The three centres of gravity of the sections lie at the same distance from the axis of rotation. The circumferences of the three sections are alike. If we now suppose an equal number of equal bobbins applied on each ring, the number of coils, the length of wire and the resistances of the three rings are alike. But the square ring has the advantage of containing most iron. If we call the respective sections of the iron f_1, f_2, f_3, we have the following relations :—

$\frac{x}{y}$	Cylinder ring.	Flat ring.
1	$f_1 = f_3$	$f_2 = f_3$
3/2	$f_1 = 0{\cdot}96\, f_3$	$f_2 = 0{\cdot}96\, f_3$
2	$f_1 = 0{\cdot}91\, f_3$	$f_2 = 0{\cdot}91\, f_3$
3	$f_1 = 0{\cdot}75\, f_3$	$f_2 = 0{\cdot}75\, f_3$
4	$f_1 = 0{\cdot}64\, f_3$	$f_2 = 0{\cdot}64\, f_3$
9	$f_1 = 0{\cdot}36\, f_3$	$f_2 = 0{\cdot}36\, f_3$
99	$f_1 = 0{\cdot}04\, f_3$	$f_2 = 0{\cdot}04\, f_3$

It is evident that the square ring is by far the most advantageous as regards the iron section. It especially exceeds the cylinder ring in which the ratio $\frac{x}{y}$ has a high value. In Gramme machines we have the $\frac{x}{y} = 6$; the section of the iron being only half the section of the square ring. Flat rings are not generally constructed in such abnormal proportions and the position of affairs is not quite so unfavourable. Besides, in the flat ring the diameter of the core of the magnet decides the breadth of the pole pieces, so that it would be disadvantageous to change the flat ring (fig. 2) for the square ring (fig. 3).

Here the relations for the transit of the lines from the pole pieces to the core of the ring would become decidedly less favourable. On the contrary, it would certainly be advantageous to convert the flat ring, fig. 2, into the square ring, fig. 4. The length of wire would be increased only by one-third, whilst the section of the iron would be doubled. If the circumstances were in other respects not too unfavourable, the electromotive force of the machine would be increased by more than one-third. The result of the former considerations is therefore unchanged and the square ring must be preferred to the flat ring.

If, however, we were at once to decide on the capability of the cylindrical ring from the above table, we might easily be led to estimate it too low. On the square ring, and still more on the flat ring, there remains space which is not utilised. In the wrapping there are formed wedge-shaped interstices. This loss in the cylinder ring is practically non-existent. A cylinder ring of equal iron section and equal $\frac{x}{y}$ may have a decidedly smaller diameter by which its magnetic resistance is reduced to a corresponding extent. It might therefore seem as if the cylinder ring were preferable to the flat ring. But for deciding on the merit of both forms the following consideration must be kept in view. A very essential part of the magnetic resistance consists of the resistance of the intervening stratum (filled with air and conductive matter) which separates the polar surfaces of the electro-magnets from those of the ring. The section of this stratum is double as large in a flat ring machine as in a cylinder ring machine. Hence the magnetic resistance of this stratum in the flat ring machine is about half that of the cylinder ring machine. Hereby the above-mentioned advantage of the cylinder ring machine is not merely compensated but outweighed. The above considerations do not, therefore, show that the cylinder ring machine is more effective than the flat ring machine.

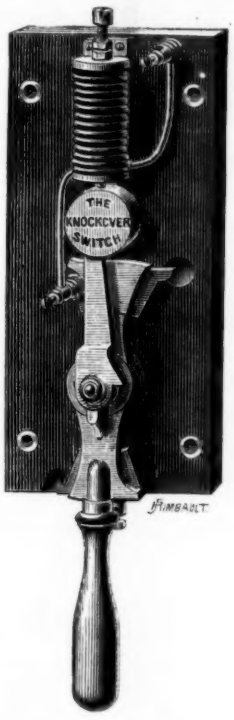
In the foregoing, the relation of the length of induced wire to the total length has not been referred to. In the square ring this proportion is 0·5 ; in a flat ring about 0·75. It is therefore simply perversity to maintain that this proportion must be very great.

The case is similar with drum machines. If that machine were best in which the above proportion = 1, drum machines would be built very long and of small diameter. This plan, however, has long been superseded and the drum rings are now made short and thick. An exception is allowed only in very large machines in which very large sections of iron do not become equally magnetised.

THE "KNOCK-OVER" SWITCH.

THE "knock-over" switch (Goolden-Trotter patent) is an ordinary double-break switch, provided with a device for automatically breaking the circuit when the current or the volts exceed a certain fixed quantity. The switch is fitted with an ordinary handle, and has large solid contact surfaces and sparking pieces.

The breaking of the circuit is effected automatically by a "knock-over," which consists of a weight at the end of a lever, pivotted upon the axis of the switch. The centre of gravity of the weight is nearly over the axis, having a slight tendency to fall, and is held in this position by a catch at the end of the core of a



solenoid. The strain on the catch is very small. There is a projection on the lever which meets with a stop on the switch after the weight has descended through about a right angle. During its fall, it acquires considerable momentum, and comes into collision with the switch with more than sufficient force to knock it over. The solenoid can be wound for high or low resistance ; and can be adjusted for any required volts or ampères, either by a spring or by weights.

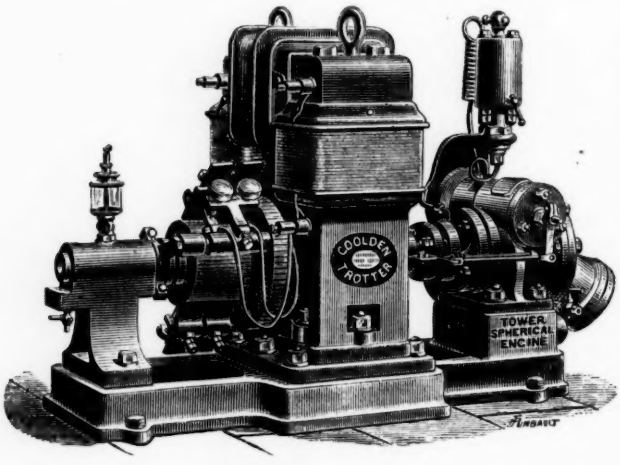
By regular use as an ordinary switch, freedom of action is ensured. When the switch is "off" under ordinary circumstances, the "knock-over" is still retained by the catch, so that it can be seen at a glance whether the current has been broken automatically or as a cut-out. We have ourselves examined this switch, and find that its action is satisfactory ; but an appreciable period elapses during the fall of the weight.

GOOLDEN AND TROTTER DYNAMO.

IT is not often that three independent individuals hit upon the same idea almost simultaneously. A new type of dynamo, so far as the arrangement of the magnets is concerned, has been introduced by Messrs. Goolden and Trotter, a very similar pattern having been recently produced by Mr. Kapp, and it appears that an American inventor is working on the same lines.

The dynamo may be described as having an Edison field in which the yoke as well as the side bars are wound. A number of these dynamos have been mounted with Messrs. Heenan and Froude's Tower spherical engine for use on the sea-going torpedo boats, the combination being probably the smallest for its weight, speed and out-put that has ever been produced.

The dimensions over all are :—height, 2 feet 3 inches ; length, 3 feet 6 inches ; width, 1 foot 6 inches ; weight,



with bed-plate, lubricators, &c., 8 cwt. The out-put is 60 ampères, 60 volts, at 650 revolutions, and at 90 lbs. steam. The engine and dynamo are easily able to produce 4,000 watts at 700 revolutions.

The dynamos for H.M.S. *Severn* and *Mersey* are larger examples of the same pattern. Messrs. Goolden and Trotter continue to make the Gramme type of dynamo (with which their name is associated) when extreme compactness is not required.

VISIT TO SILVERTOWN.

BY invitation of the directors of the India-Rubber, Gutta Percha, and Telegraph Works Company, on the occasion of the presence in London of representatives from the Colonies and India, a party of about two hundred ladies and gentlemen visited the company's works at Silvertown, on Thursday, the 10th inst.

The party started from the Temple Pier in a specially chartered steamer, and proceeded down the river to North Woolwich, where a special train was in waiting to convey the visitors to Silvertown.

With a view to call the attention of the guests to the various objects of interest met with on the trip down the river, a small guide-book had been handed to each, indicating these points and containing also a general description of the works at Silvertown.

On arrival at the works the visitors were formed into parties conducted by members of the company's staff, and no time was lost in commencing the inspection of the various workshops. Owing to the manufactures being of so varied a character, the time at disposal so limited, and as the works cover 15 acres of ground with a floor area of about 10 acres, it was hardly to be expected that a very detailed inspection could be made, and many departments were therefore left unvisited.

In the first building inspected was seen the percha in its raw state, that is as received from the East Indian Islands and the Malay Peninsula, whence the gum is principally obtained. Here also the various cleaning processes were shown. These are operations of considerable importance when it is considered that from 25 to 30 per cent. of impurities, chiefly sand and bark, have to be removed.

The first process of cleaning consists in cutting the lumps of gum, when too large, into small pieces, and boiling them in steam-heated tanks. During this operation a large proportion of the sand and of other impurities of a higher specific gravity than percha (which itself is slightly lighter than water) is got rid of.

The gum is then skimmed off the boiling tanks and is placed in the washing machines where it is further cleaned through being thoroughly kneaded by a fluted cylinder revolving in boiling water.

From these washing machines the gum is taken to masticators, where it is worked under considerable pressure and heat in order to expel the occluded moisture. The gum is then removed to the hydraulic presses, where at a pressure of about a ton to the square inch, it is forced through a series of fine wire sieves, the finest having 8,100 holes to the square inch. These sieves remove the specifically lighter impurities which the previous operations have failed to extract. For the manufacture of insulated telegraph wire and for many other applications of gutta percha, it is so necessary to have the gum absolutely free from impurities, that the foregoing operations have frequently to be repeated three or four times.

When the gutta percha is sufficiently cleansed, it is again masticated and rolled through calenders into sheets of about half an inch thick and three feet wide. In this form it is stored until required. In this workshop is also made what is called gutta percha tissue used for hospital purposes, of an exceedingly fine texture, and worth approximately about thirteen shillings per pound weight.

In passing from this building to the wire-stranding floors, the visitors were shown the large engines which supply the motive power to the washing machinery, and also the pumping engine which raises water for feeding the 31 boilers in different parts of the factory, from a well over 500 feet deep.

The water raised from this well is purified by the Porter-Clark system, thus avoiding any deleterious deposit in the boilers.

The copper wire which forms the conductor of insulated telegraph wire, which is commonly called core, is received from the wire drawers in irregular hanks or bundles; on the wire stranding floors these hanks are unrolled and the wire is straightened and coiled on bobbins. These bobbins when filled are taken to the stranding machines where they are laid up, in any number desired, in the form of one conductor, each wire having previously received a coating of adhesive compound.

The copper wire thus stranded in the form of conductors is coiled on carrying drums and taken to the covering floors. Here the conductors are hauled off the drums and drawn through the dies of the gutta percha covering machines. These dies are fed with gutta percha in a plastic state at a high and uniform pressure, and the conductors passing through the dies receive a coating of gum more or less thick according to the adjustment of the machines. The conductors thus covered pass four or five times through troughs, about 180 feet long, containing water, kept at a low temperature by refrigerating machines, in order to harden the gutta percha covering. It is usual to repeat the operation of covering three times for submarine cables and twice for underground lines. Between each operation the covering is thoroughly examined by experienced workmen, and submitted to electrical testing. This department can produce about 40 nautical miles of gutta percha core every 12 hours.

The visitors then inspected the moulding of various articles and the making of bosses for spinning machinery from gutta percha.

After passing through the electricians' room, where the copper wire used for the conductors is carefully tested, a visit was made to the temperature tank house, where the core coming from the covering floors is subjected to a temperature, in water, of 75° Fahr., and exhaustive tests made as to the electrical condition of the gutta percha.

From the tank house the visitors were conducted to the upper and lower cable shops, passing the engineers', the fitters', the blacksmiths' and carpenters' shops, where about 150 men are employed, and where the planing and drilling machines, turning lathes, wood cutting and morticing machines, and steam hammers were seen at work. The cable testing rooms were also visited, and the electrometers, galvanometers, and other electrical instruments were explained. In the lower cable shop four heavy machines were at work engaged in the manufacture of the shore ends and intermediate types of the West African Telegraph Company's cables. In the upper cable shop the manufacture of the light intermediates and deep sea types was shown.

The core as brought on drums from the tank house is placed behind the cable sheathing machines, and after receiving a serving of yarn passes through the centre of a large disc which holds the necessary number of bobbins filled with iron wire. The disc revolving as the core passes through lays the iron wire helically round the core. The cable thus sheathed receives alternate coatings of compound and tape, or yarn, and is coiled into one of the 16 large iron tanks, for storage until required for shipment.

The cable factory can turn out about 26 nautical miles every 12 hours.

Latterly more attention has been paid to the chemical composition of the bottom of sea, and to its destructive effects on some of the older types of cable; it has been found necessary in certain cases to protect each wire of the iron sheathing with a special compound and tape. For this purpose there are at Silvertown between 70 and 80 wire taping machines, which can turn out about 280 nautical miles of taped and compounded sheathing wire every 12 hours. The tanks for storing the cable in the factory have sufficient capacity for about 3,000 nautical miles of cable. The weights of different types of submarine cable vary from the heavy shore end of 20 tons per nautical mile, to light torpedo cable of about 15 cwt.

The cable stores were next visited, and the various types of grappling and buoy ropes, the different grapnels for holding, cutting, tripping, and automatic signalling were seen, as well as the wire sounding machines, weight detachers, specimen tubes, water tubes, and deep-sea registering thermometers. The system of landing shore ends by means of balloon buoys was explained, and the buoy detachment shown in action. The visitors then proceeded on board the ss. *Silvertown*, into whose tanks the West African cable was being coiled. To show the advantage of large cable tanks such as this ship carries, we may mention that over 120 nautical miles has been coiled into one tank during 24 hours. These large tanks are still more advantageous for the paying out of cable; the *Silvertown* on one occasion having a long stretch of good bottom, was able to lay 219 nautical miles in 24 hours. These tanks are three in number, and are 53 feet in diameter and 32 feet deep. They have carried 2,400 nautical miles of cable, representing 4,900 tons; the total cargo, however, including coals and stores, was on this occasion 7,600 tons.

The *Silvertown* is the largest cable ship afloat, but is closely followed by the *Faraday*, owned by Messrs. Siemens Brothers.

The manner in which the picking up and paying out machinery is employed was then explained. The former is of a very powerful description, and for the convenience of working has two drums which can be thrown in and out of gear with the picking up engine, as may be desired. It was originally designed by the late Prof. Fleeming Jenkin, but has since been modified in certain details by the Silvertown Company. The paying out machinery is of the usual type, except that it has a powerful engine attached which is found serviceable in many ways. The dynamometers are of the usual vertical type. In connection with the paying out gear there are indicators for measuring the length of cable paid out, and a strophometer for registering the speed of rotation of the paying out drum.

On the taffrail is placed a wire sounding machine, geared to a small rotary engine, and always kept ready for immediate use.

The vessel is fitted with incandescent lights between decks fore and aft, and for deck work she carries three movable arc lamps. Her usual crew numbers about 200 men, including some 40 engineers, electricians and officers. When fully loaded she averages 10½ knots on a coal consumption of about 30 tons per 24 hours. She has a coal capacity of about 2,100 tons.

While the guests were passing between the ship and shore several torpedo experiments were carried out, among which the most noticeable was the throwing up of a large column of water to a height of 70 or 80 feet.

Before proceeding to lunch the manufacture of electric lighting conductors was witnessed. Amongst the various types the most remarkable was a conductor of which the copper alone weighed about 10 tons to the statute mile, and which was manufactured for a French company.

In the same building, but on another floor, there were seen at work the braiding machines, about 60 in number. These machines are employed in covering the small conductors used for domestic electric bell work, and for covering military field telegraph wire.

On another floor in this building the visitors were shown the manufacture of India-rubber covered wire used in places where the employment of gutta percha covered wire would be unadvisable. The vulcanisation or casing of this rubber-covered wire was explained during the visit to the India-rubber departments.

The visitors were then entertained at lunch in one of the factory buildings.

They were afterwards conducted to the battery shop where the manufacture of the various types of batteries was shown, the most important article in this branch being the Léclanché batteries, of which the Silvertown Company is the sole licensee for Great Britain and the Colonies, and of which large numbers are turned out every day. Here were also seen the large batteries used on board men-of-war for firing broadsides, as well as smaller types for torpedo work. In connection with the subject of batteries the visitors were shown the manufacture of carbon plates and of depolarising agglomerate blocks. In the same shop is carried on the manufacture of carbon rods for electric lighting, which vary in diameter from one-sixteenth of an inch to an inch-and-a-half, according to the purposes for which they are required.

The electric lighting department was then visited. On the ground floor are mounted the various dynamos and other plant necessary for lighting up the factory and for experimental purposes. For the ordinary lighting 10 double-disc dynamos of the Silvertown pattern are employed, and two others are kept in reserve. These machines serve 137 arc lamps, each of 2,000 candle-power, placed inside the various buildings, and 10 arc lamps, each of 3,000 candle-power, employed in the illumination of the roads and streets in the works. Besides the 137 arc lamps used for general internal purposes, a system of incandescent lighting is being gradually established where it is locally necessary, such as at lathes, at workmen's benches, and at certain parts of machinery. The present number of incandescent lamps in use is about 900, and it is intended to increase this number to 1,200 or 1,500.

Among the advantages of electric lighting are a larger quantity of light and a purer atmosphere. These enable the work to be carried on under more satisfactory conditions both as to quality and quantity. It is also estimated that without allowing for the in-

creased quantity of light, a saving of from 16 to 17 per cent. is effected. In order to avoid risk of fire, the electric light conductors are covered throughout with insulating material, and the greater portion are laid underground in concrete trenches.

On the same floor was seen the switch board and circuit testing room, from which the various circuits radiate. While here, several tests and experiments were made, to show the power of the dynamo machines, the most striking being the fusing of a steel wire about 15 inches long and $\frac{1}{4}$ inch diameter, by the current from an incandescent lighting dynamo. On this floor was also seen the manufacture of the arc lamps, and of certain portions of the dynamos, the rest of the work on these machines having been already seen in the engineers' and fitters' shops.

On the next floor the visitors were shown through the electric lighting drawing office where various designs for lamps and dynamos were inspected, and were then taken to the electricians' testing room, where the different instruments, such as galvanometers, ampèremeters, voltmeters, and electro-dynamometers, were explained. The large photometer for measuring the comparative powers of different lights was shown and described, as well as the manner of fitting and finally adjusting the arc lamps.

The torpedo shop was next examined, and some experiments were carried out showing how submarine mines are employed for offensive and defensive purposes. There were noticed the arc firing apparatus, the shutter indicator, the large gun cotton cases, the circuit-closer cases, the magneto and frictional exploders, the disconnectors, and a number of other interesting appliances used in torpedo warfare, among them being the holophotes, with lenses and powerful reflectors, used with electric lamps as search lights on board ship and in forts for discovering the approach of an enemy.

As a demonstration of the transmission of power by electricity, though the experiment was of no practical value, a series of secondary or storage batteries (previously charged from a dynamo machine) actuated an electro-motor, which drove a dynamo, and this in its turn supplied sufficient current for electric lighting.

A visit was then paid to the instrument department, where about 70 skilled hands are employed in the manufacture of electrical apparatus, such as astatic galvanometers, condensers, resistance coils, and other appliances used in electrical testing. Here were also seen the various instruments used for communicating through aerial and submarine telegraph lines, for instance the mirror instrument, the Morse, the single and double needle, sounders, &c. Besides these, there were shown the various instruments employed on railway lines for the safe conduct of the traffic, and notably amongst these Preece's block instrument and Walker's train describer. A considerable number of telephones and other instruments are also turned out.

The visitors then inspected the India-rubber department, where they were first shown the gum in its crude state as it arrives from Brazil, Guayaquil, Ecuador, Central America, East and West Coast of Africa, Madagascar, and the East Indies. There is so much foreign matter, such large pieces of clay, stones, iron, wood, &c., found in the majority of gums that it is necessary to cut the lumps open by manual labour. When this matter is picked out, the India-rubber is placed in tanks of boiling water to soften it, and is then passed through a series of washing machines, which besides washing thoroughly amalgamates it. After this process the gum is taken to a heated room, called the stove, where it remains for some time, and becomes perfectly dried. From this room it is taken as required for manufacture.

The next process is the mixing, and on account of the numerous varieties of gum, probably 20 in number, and differing materially from one another, the mixtures with sulphur and various pigments have to be very carefully considered, both with regard to the particular variety of the gum and the purpose to which the material is to be applied. In mixing, the principal additions to pure rubber are bi-sulphide of antimony, litharge, oxide of iron, French chalk, lamp-black, besides other pigments, and in all cases a certain percentage of sulphur is used, as this is the chief agent in the process known as vulcanising or curing.

The classes of manufacture can be generalised under two heads, one, the production by dry mixing of materials destined to produce what is known as solid goods such as railway buffers, valves, &c., and the other, the mixing of rubber in solution with the various pigments for the production of "spread" goods such as waterpoof coats and sheets. The dry mixing is effected by working the rubber between heated rollers and adding the pigments as required. This mixture is then placed in the heating machine preparatory to being run through the calender rollers to produce a sheet of the thickness required for the special object in view. This sheet is taken to the cutting shop where it is cut out in the shape desired. The material is then cured or vulcanised, depending on the purpose to which it is to be put, either by being placed in a mould and cured under hydraulic pressure, or imbedded in French chalk and submitted to high temperature in an oven, or rolled on a cylinder and boiled under pressure, or dipped in a boiling sulphur bath. The curing of rubber consists in submitting it to a heat of from 260° to 290° Fahr. in the presence of a certain proportion of sulphur.

In this shop was seen the manufacture of valves, railway buffers, washers, rubber rings, mats, wheel tyres, tennis balls, ink erasers, bottle stoppers, &c. Some idea of the extent of this shop may be gathered from the fact that there are eight engines constantly at work, the largest of which is of 500 horse-power.

The spreading shops, where the rubber in a state of solution is laid on cloth or other material for the purpose of waterproofing, were next visited. Twenty-four spreading machines were at work, and their ordinary production is over 10,000 yards per week, but their working capacity is far in excess of these figures. It was explained that to ensure perfect waterproofing the best classes of material are passed through the machines as often as ten times. The visitors were then taken to the waterproof tailoring department, where some 200 hands are employed. The vulcanising of this class of goods, called the semi-cure, was not visited on account of the offensive smell from the curing agents, bisulphide of carbon and chloride of sulphur.

The hose or pipe-making and the belting or driving band shops were then inspected. On account of the special work each of these shops is about 180 feet long, and about 40 feet broad. They are fitted with long curing ovens, in which the hose or piping is vulcanised in lengths of about 80 feet. The belts or driving bands when made are taken to the presses for curing.

The large chemical laboratory presented considerable attractions, but the time being short the visitors were hurried to the ebonite shop, where the manufacture of an infinite variety of ebonite articles was witnessed. It is here that large pumps and piping in ebonite for the Rio Tinto and other copper works, and for manufacturers of acid are made, ebonite being the only material successfully employed in works of these kinds. It was explained that ebonite or vulcanite is (without entering into much detail) ordinary rubber with an increased proportion of sulphur and a longer exposure to a high temperature ; this change of treatment altering completely the nature of the material, which loses its elasticity, and can be worked in almost the same manner as wood or iron. The visit here terminated, and the guests were conveyed to London by a special train.

Before leaving we were informed that at the company's works at Persan-Beaumont, France, very much the same manufactures are carried on, but naturally on a smaller scale, only 300 people being employed there, whereas at Silvertown there are about 2,000 work people. From the position of these works very little submarine work has been done, but a great deal of work of various kinds has been there executed for the French Government. We understand that a con-

siderable quantity of belting of a metre wide was made there as a special order for the Panama Canal Company, these being the only works in France which could execute the order.

Among the visitors to the works we noticed the following gentlemen :—

Chief Justice Dobson, Tasmania ; Captain Da Silva, Portuguese Navy ; Baron de Costa Ricci ; Hon. W. Wilson, Victoria ; Dr. Julius Von Haast, C.M.G., New Zealand ; Capt. Roche, Gambia ; Major-General Sir Peter Lumsden, G.C.B. ; Hon. C. Oinmet, Quebec ; Capt. Fitzgerald, R.N. ; General Sir E. Selby Smyth, K.C.M.G. ; Lieut.-General Sir Harry Lumsden, K.C.S.I., C.B. ; Sir Samuel Davenport, South Australia ; Capt. Verney, R.N., M.P. ; Count Thadée d'Oksza ; Major-General Sir Wm. Crossman, R.E., K.C.M.G., M.P. ; Sir Juland Danvers ; Capt. J. E. Hunter, R.N. ; Sir Fredk. Goldsmid, K.C.S.I., ; Mr. Graves ; Mr. Henry Ford ; Sir Henry Mance, C.I.E. ; Mr. Baughan, C.B. ; Mr. W. H. Preece, F.R.S. ; Mr. W. H. Winter ; Capt. Hixson, R.N. ; Mr. Sivewright, C.M.G. ; Hon. Mr. Ross, Canada; Mr. Owen Lewis, Chairman of the Spanish National Telegraph Company ; Mr. John Miles, Director of the West African Telegraph Company, and Mr. Thomas Fuller, Managing Director of the African Direct Telegraph Company. The directors of the Silvertown Company who received the guests were Mr. Silver, the Chairman of the Company, Messrs. Bannatyne, Scott, R. Henderson and M. Gray.

A NEW PRIMARY BATTERY.

A DECIDED new departure from the well-worn groove in which experimenters on primary batteries have hitherto worked is a novelty which is deserving of more than a passing notice. The new battery, which is the invention of Mr. Upward, the head electrician to the Woodhouse and Rawson Electric Manufacturing Company, occupies an intermediate position between the gas battery of Grove and the ordinary primary element. To a certain extent the idea is not new, as anyone who has read through the pages of the *Electrician*, an electrical journal which had a brief existence of about two years, a quarter of a century ago, will remember that many attempts were then made to construct batteries on somewhat the same lines as those followed by Mr. Upward, but apparently without any success. The energetic action of chlorine in a gas battery was pointed out by Grove, and it seems probable that this fact has been a suggestion to the inventor of the new battery. Briefly speaking, the construction of the latter is as follows :—The elements are the ordinary carbon and zinc, or carbon and iron, and the battery is maintained in active condition by the passage of chlorine gas through the cells. Each cell consists of an outer and inner vessel ; the outer one, which is of glazed earthenware, is provided with air-tight inlet and outlet pipes, while the inner vessel is an ordinary porous pot. Between these two vessels the carbon plates are placed, and tightly packed in with crushed carbon, cement is then used to seal the top of this outer chamber. In working the battery the most ordinary commercial zinc cast into blocks, and without any amalgamation, is placed in the inner cell, which is then filled up with plain water. Chlorine gas, which may be obtained from common chloride of lime, is then admitted to the outer or sealed chamber, and circulates from cell to cell through the whole system. The pressure inside the cells being less than atmospheric pressure, there can be no leaking of the gas.

In order to supply the cells with a constant flow of chlorine, a simple gas holder, working on the displacement principle, is used, chlorine being two-and-a-half times the weight of air. This gas holder, which has no moving parts or valves of any kind whatever, is capable of holding sufficient to work the battery without interruption, even although the gas may be generated at intervals.

Owing to the comparatively high resistance of the cells (about ·2 ohm) the battery is not used direct for electric lighting purposes, but is connected to a secondary battery or accumulator, so as to enable it to be worked at its highest efficiency, automatically charging the cells night and day without stopping.

The advantages which are claimed are :—1. No emptying and filling the cells with acids or chemical solutions of any kind whatever is required, plain water only being added occasionally.

2. The plates are never touched or moved in the battery from the time the zincs are put in till they are completely used, which, if required, need only be about once in six months of usual electric lighting work.

3. When the battery is at work the zincs are consumed perfectly evenly, down to a thin wafer, thus using the whole plate without waste. Since the action of the battery is purely electric, all the zincs will be consumed evenly with one another, and may all be renewed on the same day.

4. The carbon plates are once for all sealed into their places, and never removed.

5. The battery may stand idle for months, and the zincs will be absolutely untouched.

6. There is no creeping, and consequently the terminals are not liable to corrode or require cleaning or screwing up.

7. There is absolutely no polarisation whatever.

8. Local action is impossible, owing to the electrolytic action of the battery.

9. No washing of porous pots or other parts of the battery is required.

10. There is no smell, dirt, or obnoxious vapour.

11. The removal of the plates for amalgamation is not necessary, and the cheapest scrap cast zinc can be used.

12. The whole apparatus may be left standing for months without any depreciation, and will start instantly when desired.

13. One of the chief features of the battery is its permanent nature. All that is necessary is to make the gas, which by the special design of generator is rendered exceedingly simple, and does not occupy more time than trimming two or three oil lamps.

14. The light is available at any hour of the day or night, and is absolutely constant and steady.

15. Light can be turned on and off as required without altering the amount of light given off by the remaining lamps.

16. The high E.M.F. (2·1 volts) is that due to the direct action of chlorine on zinc, and is not obtained by the use of a depolariser as in other high E.M.F. batteries.

The general construction of the battery (of which we shall have more to say) is most substantial and satisfactory, and we consider that the invention is a very close approach to the theoretical perfection as regards economy which it is possible to obtain from a primary battery in which zinc is used as the positive element.

Finding Buried Miners.—In its Paris letter, *Science* for May 7th, mentions a very ingenious and valuable device by which some workmen buried in a mine near Périgueux, in the south of France, were sought. After these workmen had been buried by an avalanche of rocks and earth, MM. Siemens and Langlois, the engineer and photographer, finding that all attempts to communicate with them proved ineffectual, had a hole bored down directly into the cave, large enough to admit of passing provisions and tools, and they sent down into the hole an electric lamp strong enough to illuminate the whole cave, and after that a photographic apparatus. The plate, after some time of exposure in the cave, came up so perfectly impressed that it revealed the exact state of things. True, the scene was ghastly indeed, and dead bodies only were pictured by it, but the experiment proved that this plan may hereafter be resorted to with success in mine accidents.

BLEACHING BY ELECTRICITY.

IN the field of electro-chemistry one of the most interesting and ingenious operations of a practical character is that invented and brought to a stage of commercial success by M. Hermite, in which the process of bleaching is carried out by electrolysis, and to which reference was made in the REVIEW of February 5th last. The method was exhibited and explained at the Antwerp Exhibition, and since then has been in practical operation on a business scale at Lille. M. Hermite is now in London, and Messrs. Paterson and Cooper having been appointed his sole licensees are commencing the manufacture of the requisite plant on a scale commensurate with the expected demand from the bleaching works of the United Kingdom. One great advantage claimed for the electric process is that a saving in cost is effected of about 50 per cent. as compared with the use of bleaching powder; and another is, that it does not involve that danger to the tissues operated upon, which exists in the present process, owing to the presence of lime in the bleaching solution. Under the present system textile materials are not bleached perfectly white, but at a certain stage of the chemical process have to be withdrawn from its influence and perfected by the tedious operation of bleaching on grass. This is rendered unnecessary by M. Hermite's mode of working, the bleaching being completed with the one operation, thus effecting an economy of both time and money. The working of the apparatus is very simple, and by means of an ammeter and voltmeter it can be regulated and controlled at any distance from the bleaching tanks. A solution of chloride of magnesium is submitted to the action of an electric current with an electromotive force of 4 volts through platinum electrodes, causing chlorine to be liberated, and at the same time oxygen from the water; a cycle of changes taking place which result ultimately in the regeneration of the chloride of magnesium. There is, therefore, no practical loss in the chloride of magnesium, and it is due to this fact, together with its low price (£2 per ton as compared with £6 10s. for bleaching powder) that the plan shows such a saving of cost as compared with that generally adopted hitherto.

THE STRANGE HISTORY OF A DYNAMO

As told by itself to

A. DYNAMICABLE.

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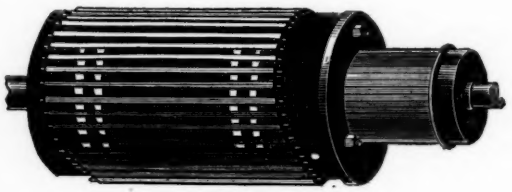
(*Continued from page* 551.)

THE name of Edison has held a strange sway over the masses for several years past, and has been most successfully employed by unscrupulous speculators as a means with which to conjure. When it was announced that the "Wizard of Menlo Park" had succeeded in subdividing the electric incandescent light, down went the gas shares to panic prices.

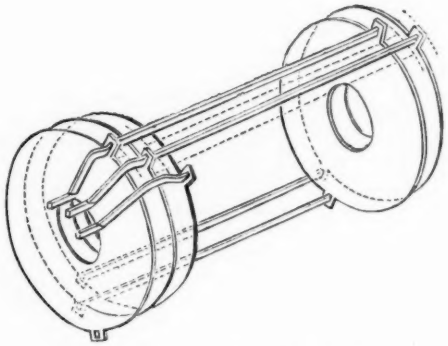
It is not only amongst the ordinary public, however, that Edison exercises such a peculiar fascination; even the greatest of your legal luminaries cannot free themselves from his mysterious influence. He has been held to be the inventor, without a shadow of reason, of every conceivable telephonic transmitter. He is credited with being legally entitled to claim a monopoly in incandescent electric lamps, although they had been employed in various forms years before his time, and no one, least of all your humble servant, would be surprised to find that if it were thought advisable to set him up as the inventor of myself and family, the prior discoveries of Varley, Wheatstone, Siemens, Gramme and others would be set at nought. Edison, the designer of the phonograph, or "talking machine," is, in the public mind, a great and original inventor. In reality he is an exceedingly clever adapter of and improver upon old and almost forgotten ideas which from want of means, or from other causes, had never been carried to finality, and had been laid aside *pro tem.*

To the man who has a liking for and a smattering of scientific knowledge, and who keeps himself *au courant* with the progress of invention by reading sensational, and almost invariably inaccurate newspaper paragraphs, Edison is a name to swear by to the utter exclusion of others before or since.



ARMATURE.

It must not be supposed, however, that I depreciate the constant and successful labours of this fortune-favoured American. By means of the money at his command, with which he has been lavishly endowed from the very commencement of his electrical career, and the co-operation of clever helpers in all the domains of his researches, he has been enabled to give the world the benefit of many important additions to its progress which might otherwise have still lain dormant. In science, as in everything else at the present day, there is a little too much of the hero worship of the successful man who turns the ideas which others have promulgated to business or commercial account, and too little heed is given to the patient and oftentimes nearly forgotten investigator whose earlier labours have been exhumed, "resurrected" and transfigured almost beyond recognition, except to the earnest student.



METHOD OF COILING ARMATURE.

But to our history. I have said that the Edison form of dynamo somewhat resembles that of Siemens, insomuch that the coiling of the armature is identical in principle. In practice, however, the methods adopted in the two cases are quite distinctive features. The Edison armature, as generally constructed, is not coiled with wire as we understand it, but with copper bars, and in this respect it much resembles the coiling of the old electro-plating Gramme machines, as well as those manufactured by Siemens for the same uses.

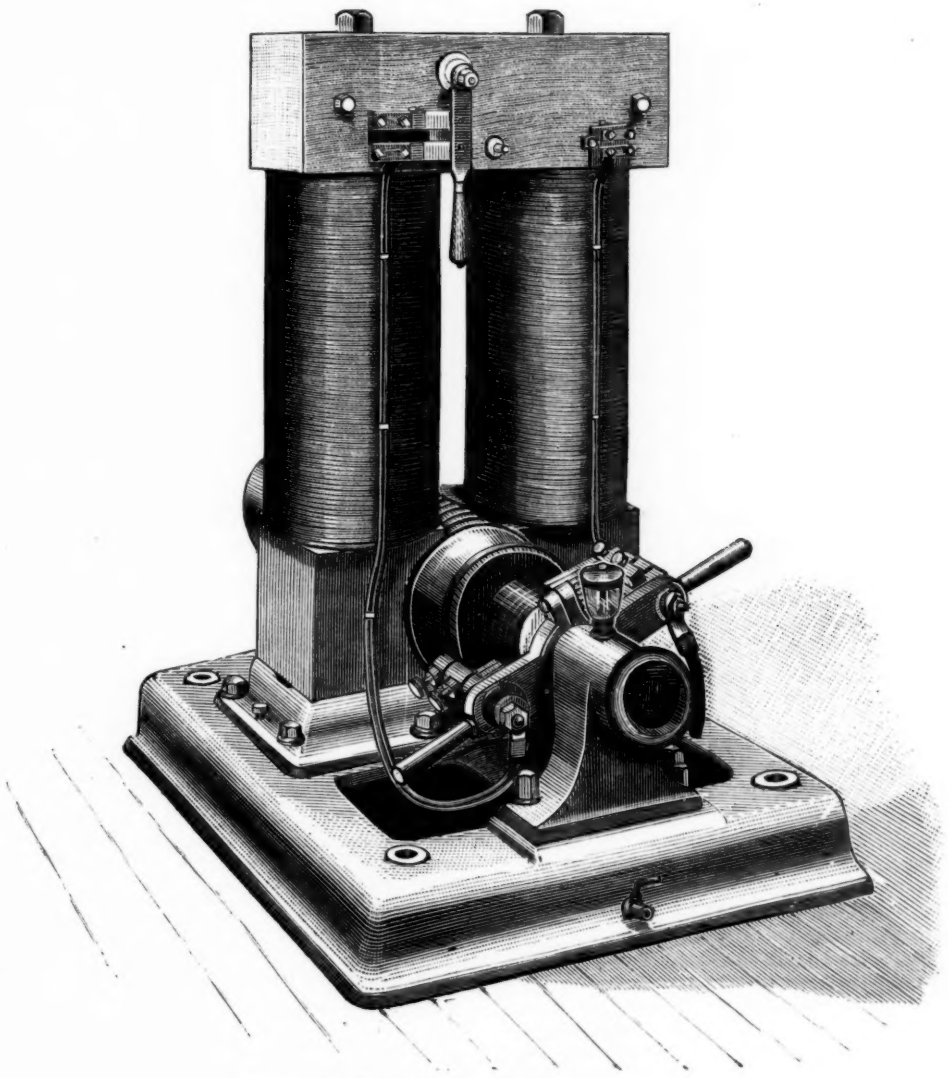
These bars, however, only cover the outer surface of the armature; and as it would have been an awkward matter, if not one of sheer impossibility, to bend these massive bars over the ends of the armature, as Siemens coils his wires, Mr. Edison adopted a very ingenious device for obviating this difficulty. The figure shows an Edison armature in its complete form, and it will be seen that the ends of the copper bars are connected across from one side to the other by discs or rings of copper threaded upon the axle and carefully insulated one from the other.

These discs are provided with projecting lugs to which the copper bars are attached. The method of connecting up may be made still more plain by means of a diagram, in which the alternate discs and bars are represented by dotted lines. The coils, each of which, you understand, consists of a copper bar on each side of the armature, are connected to a collector of the form I have previously described. The figure, as you can see for yourself, does not give an idea of the internal construction of the armature, nor indicate the means provided for the suppression of the Foucault or "eddy" currents, to whose deleterious influences I alluded when speaking of my Brush form. The core of the armature is, in fact, built up of a series of thin iron washers carefully insulated or separated from one another by mica or paper.

The field magnets designed by Edison for his armatures were not of a form such as one would expect from one of his knowledge and experience; they were, indeed, very defective, as we have since learnt.

Dr. Hopkinson, F.R.S., one of your leaders in science, has quite recently very materially improved my Edison form; some of these improvements being in the field magnets, rendering them much more effective, others having been introduced in the armature, still further eliminating the "eddy" currents, which circulated somewhat freely in the earlier forms. This machine, unlike the Brush, is chiefly used for producing the current for incandescent electric lighting, although it has been employed in a very limited capacity for arc lamps. This large illustration gives a capital idea of the Edison-Hopkinson form into which members of my family have been turned. They have met with considerable favour in this country, although naturally they are more generally sought after on the other side of the "herring pond." The principles which underlie the various fashions under which I have thus far presented my counterparts to you are common to all of us, and with the bare mention of a few of my brethren who are best known I think I must very shortly bring my history to a conclusion.

(*To be continued.*)



AN EDISON-HOPKINSON DYNAMO.

CONFERENCE ON SUBMARINE CABLE PROTECTION.

WE notice from the official report of this Conference, issued by the Ministry of Foreign Affairs, that all the clauses of the Convention of 1884 have been ratified with the exception of Articles 2 and 4, the text of which gave rise to considerable discussion These Articles are as follows:—

"Article 2.—The breaking of or injury to a submarine cable when effected voluntarily or through culpable neglect and which might result in the interrupting or impeding either wholly or in part of telegraphic communications, is punishable, in addition to the civil action for damages."

"This law does not apply to the cases of break or injury resulting from the legitimate endeavour to protect life or secure the safety of vessels, after all necessary precautions have been taken to avoid such break or injury."

C

"Article 4.—The proprietor of a cable who by the laying or repair of this cable breaks or injures another cable must bear the cost of the repair which this break or injury may have rendered necessary, and shall be liable, if there are any reasons for it, to the application of Article 2 of the present Convention."

The Submarine Telegraph Act (Great Britain) of August 6th, 1885, says in Article 4:—

"Article four of the Schedule to this Act shall not apply to that part of a cable which is laid in a depth of water exceeding one hundred fathoms; but nothing in the Convention or this Act shall take away, prejudice, or affect any right or remedy to which by law any party is or may be entitled otherwise than under the provisions of the Convention or this Act."

Mr. Kennedy, on behalf of the British delegates, pointed out that as English companies owned the greater portion of submarine cables they were naturally anxious that their claims should be favourably considered. He stated that the depth of one hundred fathoms was fixed upon as the limit of responsibility since that depth was beyond the limits of anchorage, and practically the extreme limit at which cables ran a great risk of being injured. He, therefore, asked that Article 4 of the English Act should be substituted for Article 4 of the Convention.

The committee having presented its report, and the clauses referred to having been discussed, it was resolved to define the meaning of said clauses in the following terms:—

"Certain doubts having arisen as to the interpretation of the word 'voluntary' inserted in Article 2 of the Convention of the 14th March, 1884, it is understood that the application of penal responsibility mentioned in the said Article does not apply to cases of break or injury occurring accidentally or necessarily while repairing a cable if all precautions have been taken to avoid these breaks or injuries."

"It is also understood that article 4 of the Convention has no other object and should have no other effect than to entail upon the proper tribunals of each country according to their laws and with regard to the circumstances of the case, the duty of deciding the question of the civil responsibility of the proprietors of a cable who through the laying or repairing of this cable should cause a break or injury to another cable, and to decide upon the consequences of this responsibility should it be proved that such exists."

We understand that the following cable companies were permitted to give evidence before the committee appointed by the Conference, but they were not allowed to take any part in the discussion, or to vote.

	Capital.	Cable owned
		N. M.
Anglo-American Telegraph Company ...	£7,000,000	10,437
Black Sea Telegraph Company	130,000	351
Brazilian Submarine Telegraph Co. ...	1,450,000	7,496
Cuba Submarine Telegraph Company..	220,000	940
Direct Spanish Telegraph Company ...	235,379	1,175
Direct United States Cable Company ...	1,214,200	2,983
Eastern Telegraph Company	5,643,995	19,121
Eastern & South African Telegraph Co.	950,000	3,864
Eastern Extension Telegraph Company	3,560,000	12,612
Platino-Brazilian Telegraph Company...	483,480	1,058
West India and Panama Telegraph Co.	1,325,530	4,119
Western and Brazilian Telegraph Co....	1,498,650	2,543
West Coast of America Telegraph Co....	450,000	1,699
Totals	£24,161,234	68,398

THE ELECTRIC LIGHTING ACT AMENDMENT BILL.

THE Select Committee of the House of Lords having completed their enquiry into the question of amending the Electric Lighting Act of 1882, and the House of Lords having adopted the Bill which the Select Committee approved of, we are now in a position to explain the proceedings of the Committee, and to describe the result they have arrived at. Had not the enquiry been conducted with a degree of privacy unusual even in the Upper House of Parliament, we should have been able to record the labours of the Committee as they proceeded, as we did in 1882, and on other like occasions. In this instance, however, not only were the Press and the public excluded, but the witnesses were sternly enjoined to preserve their own counsel, and agents and other semi-official persons deeply concerned in the matter were only admitted upon special points and under the most rigid conditions. Even now the evidence is not published, but we have before us, at all events, a general view of the procedure adopted, and the Bill finally accepted and sent up to the House by the Committee. It will be remembered that with a view to remedying certain defects in the Act of 1882—especially the provision relating to the compulsory purchase of an installation at the end of 21 years, without compensation or allowance for profit, goodwill, or anything else—three Bills were introduced in the House of Lords this Session, viz.: by Lord Rayleigh (on behalf of the Electric Lighting Act Committee of 1884), Viscount Bury, and Lord Houghton (virtually representing the Government). After some debate these three Bills, differing somewhat broadly on material points, were referred to a Select Committee, consisting of the Earl of Camperdown, who became chairman, Earl Cowper, Lord Ashford (Viscount Bury), Lord Balfour of Burleigh, Lord Rayleigh, Lord Wigan (Earl of Crawford and Balcarres), Lord Methuen, Lord Houghton, Lord Wolverton, Lord Bramwell, and Lord Lingen.

This Committee met for the first time for actual business on May 10th, and in the meantime a large number of petitions for or against the respective Bills were presented to the House and referred to the Committee. Against No. 1 Bill (Lord Rayleigh's) petitions were presented from the Corporations of Birmingham, Newcastle, Liverpool, Blackburn, Bolton, Burnley, Glasgow, Manchester, Nottingham, Paisley, and Hanley, the Dundee Gas Commissioners, the Mile End Vestry, the City of London Commissioners of Sewers, and the Metropolitan Board of Works; while there petitioned in favour of the Bill, the Society of Arts, the Institution of Civil Engineers, and Lord Thurlow's Electric Lighting Act Committee; and for the amendment of the Bill, the Poplar Board of Works, the Gateshead Corporation, and the Strand Board of Works lodged petitions. No petitions appear to have been presented in support of No. 2 Bill (Lord Ashford's), but the Metropolitan Board of Works, the Dundee Gas Commissioners, the Commissioners of Sewers, and the Corporations of Birmingham, Newcastle, Liverpool, Blackburn, Bolton, Burnley, Manchester, Nottingham, Glasgow, Paisley, and Hanley, petitioned against it—the Strand Board of Works alone petitioning for the amendment of the Bill. In like manner all the last-named bodies (except the Newcastle Corporation and the Strand Board of Works) petitioned against No. 3 Bill (Lord Houghton's), and likewise the Electric Lighting Act Committee, the Dynamicable Society the Society of Arts, the Society of Telegraph Engineers and Electricians, the Institute of Civil Engineers, and Messrs. R. E. Crompton and Company. The Corporation of Leeds alone presented a petition in favour of the Bill, while the Newcastle Corporation and the Strand Board petitioned for amendments. The Corporation of Edinburgh petitioned that none of the Bills should be allowed to pass into law until the Municipal Corporations had been heard upon them. From these facts it would seem that none of the Bills was really desired, while all three were strongly objected to; but this view is misleading until it is remembered that in most cases the petitioners prayed "to be heard by counsel" against the Bills, the object being to obtain a *locus* before the Committee, and then to alter the Bills as might be desirable and possible.

Meeting on the 10th of May for evidence, the Committee held six subsequent sittings for the same purpose, during which they examined in all twenty-one witnesses (apart from occasionally consulting certain agents and others interested), viz.: Mr. Lionel Cohen, M.P., Mr. H. H. Gibbs, Professor G. Forbes, Mr. Rookes E. Crompton, Sir Frederick Bramwell, Mr. J. S. Forbes, Sir John Lubbock, Mr. John Matheson Macdonald, Mr. E. Oxford-Smith, Mr. Clement Dunscombe, Mr. G. Whiteley, Mr. Samuel G. Johnson, Mr. Hill Motum, Sir George Morrison, Mr. Preece, Mr. Robert Hunter, Major Armstong, R.E., Mr. Henry G. Calcraft, Mr. Albert C. Meysey-Thompson, the Honourable Reginald Brougham, and Mr. J. N. Shoolbred. The evidence being concluded the Committee seemed to have decided by general informal consent, to take up only No. 3 (Lord Houghton's) Bill, although it was not until the close of their proceedings that they resolved in set terms to report to the House that it was not expedient to proceed further with the other two Bills.

The leading object of these Bills was to amend Clause 27 of the Act of 1882, which enacts that where any electric lighting undertaking existed under a Provisional Order or a special Act, the local authority may "within six months after the expiration of a period of twenty-one years, or such shorter period as is specified in that behalf in the application for the Provisional Order or in the special Act, from the date of the passing of the Act confirming such Provisional Order or of such special Act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf in the application for the Provisional Order or in the special Act," require the undertakers to sell to them their undertaking upon payment of the then value of the lands, works, plant, &c., without any addition in respect of compulsory purchase, or of goodwill, or of any profits which may or might have been, or be made from the undertaking, or of any similar conditions, the Board of Trade being left to determine any other questions arising out of the acquisition. In his original Bill Lord Houghton simply proposed to amend the Act first by substituting for the passage we have quoted above, the new, short proviso, after "may": "Within six months after the expiration of the prescribed period, and within six months after the expiration of every subsequent period of ten years, or such shorter period as is specified in that behalf in the Provisional Order or special Act;" and then adding at the end of the 27th section, thus modified, the clause: "In this section the expression 'prescribed period,' used in relation to the purchase of any undertaking, or part thereof, shall mean such period, not exceeding forty-two years from the date of the passing of the Act confirming the Provisional Order, or of the special Act authorising such undertaking, as may be specified in that behalf in such Provisional Order or special Act; provided that where no period is so specified the prescribed period shall be deemed to be a period of thirty years, and that no period exceeding thirty years shall be so specified in relation to the purchase of any undertaking or part thereof, except with the consent of the local authority within whose jurisdiction such undertaking, or part thereof, will be."

This was the whole of the noble lord's Bill, but in committee it was not only considerably altered, but enlarged, and practically made a new Bill, as will be seen below. The period in the existing Act of 21 years (with successive 7 year periods), has been altered to 42 years (with succeeding 10 year periods); the difficulty respecting the question of compensation or other allowance, has been dealt with by empowering the Board of Trade to vary the terms of purchase prescribed in the Act of 1882; and elaborate provisions have been introduced with regard to the laying down of electric wires, in the interest of the Postmaster-General and the public at large. The Bill so amended was reported to the House of Lords, and in that form it was passed through Committee of the House, at the last sitting before the recess.

Appended is the full text of the Bill:

A BILL [AS AMENDED BY THE SELECT COMMITTEE] INTITULED AN ACT TO AMEND THE ELECTRIC LIGHTING ACT, 1882.

Be it enacted by the Queen's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. Section 27 of the Electric Lighting Act, 1882, shall be read and construed as if the words—"within six months after the expiration of a period of 21 years, or such shorter period as is specified in that behalf in the application for the Provisional Order or in the special Act, from the date of the passing of the Act confirming such Provisional Order or of such special Act, and within six months after the expiration of every subsequent period of seven years, or such shorter period as is specified in that behalf, in the application for the Provisional Order, or in the special Act," had been originally omitted from the sixth and following lines thereof and in lieu thereof the following words had been therein inserted: "within six months after the expiration of a period of 42 years, or such shorter period as is specified in that behalf in such Provisional Order or special Act from the date of the commencement of the Act confirming such Provisional Order or of such special Act, and within six months after the expiration of every subsequent period of ten years, or such shorter period as is specified in that behalf in such Provisional Order or special Act."

2. Notwithstanding anything in section 27 of the Electric Lighting Act, 1882, the Board of Trade may by any Provisional Order to be made by them under that Act, if they think fit, vary the terms upon which any local authority may require the Undertakers to sell, and upon which the Undertakers shall be required to sell to such local authority their undertaking or so much of the same as is within the jurisdiction of such local authority under the said section, in such manner as may have been agreed upon between such local authority and the Undertakers.

3. (1.) Where in any case any electric line or other work may have been laid down or erected in, over, along, across, or under any street, for the purpose of suppyling electricity, or may have been laid down or erected in any other position for such purpose in such a manner as not to be entirely enclosed within any building or buildings, or where any electric line or work so laid down or erected may be used for such purpose otherwise than under and subject to the provisions of a license, order, or special Act, the Board of Trade, if they think fit, may, by notice in writing under the hand of one of the secretaries or assistant secretaries of the Board of Trade, to be served upon the body or person owning or using or entitled to use such electric line or work, require that such electric line or work shall be continued and used only in accordance with such conditions and subject to such regulations for the protection of the public safety and of the electric lines and works of the Postmaster-General as the Board of Trade may by or in pursuance of such notice prescribe, and in case of non-compliance with the said regulations, then the Board of Trade may require such body or person to remove such electric line or work: Provided that nothing in this sub-section shall apply to any electric line or work laid down or erected by any body or person for the supply of electricity generated upon any premises occupied by such body or person to any other part of such premises.

(2.) Where in any case any electric line or work is used for the supply of electricity in such a manner as to injuriously affect any telegraphic line of the Postmaster-General, or to affect the telegraphic communication through any such line, the Postmaster-General may, by notice to be served upon the body or person owning or using or entitled to use such electric line or work, require that such supply be continued only in accordance with such conditions and regulations for the protection of the telegraphic lines of the Postmaster-General and the telegraphic communication through the same as he may by or in pursuance of such notice prescribe, and in default of compliance with such conditions and regulations the Postmaster-General may require that the supply of electricity through such electric line or work shall be forthwith discontinued: Provided that nothing in this sub-section shall apply to the supply of electricity through any electric line or work laid down or erected under and subject to the provisions of any license, order, or special Act, or which may be used in accordance with any conditions or regulations prescribed by the Board of Trade by or in pursuance of any notice given by them under this section.

(3.) If any body or person fails to comply with the requirements of any notice which may be served upon them or him under this section, such body or person shall be liable to a penalty not exceeding twenty pounds for every such offence, to be recovered summarily, and any court of summary jurisdiction, on complaint made, may make an order directing and authorising the removal of any electric line or work specified in such notice by such person and upon such terms as they may think fit.

(4.) Any notice authorised to be served under this section upon any body or person may be served by the same being addressed to such body or person, and being left at or transmitted through the post to any office of such body or the usual or last known place of abode of such person, and any notice so served by post shall be deemed to have been served at the time when the letter containing the notice would be delivered in the usual course of post, and in proving such service it shall be sufficient to prove that the letter containing the notice was properly addressed and put into the post.

(5.) In this section terms and expressions to which by the Electric Lighting Act, 1882, meanings are assigned shall have the same respective meanings, provided that the term "street" shall include any square, court, or alley, highway, lane, road, thoroughfare, or public passage or place whatever, and the expression "telegraphic line" shall have the meaning assigned to it by the Telegraph Act, 1878.

(6.) Nothing in this section shall apply to any electric line or work of the Postmaster-General, or to any other electric line or work used or to be used solely for telegraphic or telephonic purposes.

4. This Act may be cited as the Electric Lighting Act, 1886; and the Electric Lighting Act, 1882, and this Act shall be read and construed together as one Act, and may be cited together for all purposes as the Electric Lighting Acts, 1882 and 1886.

INCANDESCENT LAMP PATENTS.

EDISON *v.* WOODHOUSE AND RAWSON
AND
EDISON AND SWAN UNITED ELECTRIC LIGHT COMPANY *v.* WOODHOUSE AND RAWSON.

(*Before* MR. JUSTICE BUTT, *sitting for* MR. JUSTICE NORTH.)

(*Continued from page* 550.)

Thursday, May 13*th*, 1886—(*continued*).

PROF. DEWAR, re-examined by Mr. Aston: Calling your attention to the paragraph which occurs on the second sheet of M. Sidot's papers, in these words: "*J'ai obtenu des resultats analogues avec le lin, le chanvre, le coton, le papier, la soie*"—calling your attention to that statement, and assuming that you were operating upon a thread, and that you begun with the thread in the first instance before carbonising it, put it into your vessel, and then heated it gradually in the presence of the hydro-carbon vapour, should you then have obtained a filament like Edison's?—No.

Should you have obtained a filament which in your opinion could be usefully employed for Edison's incandescent lamps?—No.

What would have been the character of the material that you would have obtained from your thread, assuming that you had begun with the raw thread instead of beginning with the carbonised thread?—The results would be practically identical.

Can you give any reasons as a chemist for your statement that the results would be practically identical?—The deposit of carbon by the Sidot process could only take place after the carbonisation of the filament, and consequently it comes to the same thing in the end whether you insert the filament after carbonising it or before. It is a mere convenience of time.

The two stages of the process, then, will be, when you begin with the uncarbonised filament, first to effect carbonisation?—That would naturally result, in any case.

And, therefore, in your experiment yesterday, did you do anything more than carry into practical operation the second stage of the Sidot process, assuming that he begins with the raw thread?—Nothing more.

Now, I understand you to say that for the purpose of applying what my friend compendiously calls the flashing process, it would be unwise to begin with an irregular thread such as Sidot produces? It would be better to begin with the ordinary carbonised thread, would it not?—It would.

In your opinion, would the ordinary carbonised thread, as regards regularity, be more suitable for carrying on the flashing process with efficiency than the irregular Sidot thread?—Yes.

What kind of electric light, in your opinion, having regard to the year 1870 and the use of the pencils, was Sidot referring to?—The arc light.

Have you any doubt about it?—Not the least.

MR. JUSTICE BUTT: I want to ask one question, just to make it clear. Taking a filament, if filament is the proper word, produced from any of the materials spoken of by M. Sidot, could you get a regular filament or an irregular one, no matter whether you took the linen or silk or a piece of wood?—Do you mean just immediately after carbonisation?

No, after treating it by his process?—I say, irregular in all cases.

No matter whether it was a thread of linen, or silk, or a piece of wood, or whatever he uses?—It would make no difference.

CHARLES HENRY GIMINGHAM, examined by Sir Richard Webster, stated that he had for five years been employed by the Swan and Edison United Companies, and was now manager of their factory at Ponder's End. He was the inventor of a form of connection between the platinum and the carbon in an electric lamp. He had never seen any mode of connecting two substances such as carbon and platinum in the way described in his specification before the date of his invention, and he still believed it was quite new. He dispensed with all boxwood or other material between the platinum and the carbon, and put the carbon straight into the platinum. In his opinion, a lamp made in accordance with his specification would burn perfectly well.

Mr. JUSTICE BUTT: Have you used lamps so made for a long time?—Not for any considerable length of time.

Examination continued: The connections were now frequently coated over with something. The lamp produced was made in accordance with his specification, and the connections had not been squeezed as suggested by the Solicitor-General; the socket had simply been formed and the carbon filament inserted.

Sir RICHARD WEBSTER: I offer that lamp to my friends to be lit as long as ever they like.

Mr. CHARLES: It is very little use lighting it for five minutes.

Sir RICHARD WEBSTER (To witness): How long have you had a lamp made in that way kept lighted?—Say 40 or 50 hours.

Mr. JUSTICE BUTT: Without deterioration?—Without apparent deterioration.

Sir RICHARD WEBSTER: We do not suggest at all that it is not better as a commercial lamp to put something on the top.

Cross-examined by Mr. CHARLES: The mode of attaching the wire to the filament, as described in his specification, was not the one actually in use for incandescent lamps. A cement was now used. He was not aware at the time of filing his specification of the platinum sockets described by Mr. Swan, nor had he examined Mr. Swan's lamp containing those sockets. It had been explained, however, that the platinum sockets in Swan's lamp were not like his, inasmuch as they did belong to the platinum wire all in one.

Mr. ASTON intimated that this was the plaintiff's case. With regard to the infringement, the manufacture and sale of the lamp complained of was admitted.

Mr. JUSTICE BUTT: Infringement admitted, if W and R is an infringement.

Mr. MACRORY: We admit that we made W and R.

Sir RICHARD WEBSTER: I do not propose to exercise the right which, I believe, prevails in this court of summing up the evidence. I think it is not desirable to do so in this case, because I have nothing to add to the opening, however imperfect it may have been, which I presented to your lordship, as to the existing prior state of knowledge. I say that all this mass of information, some misleading and some of value, amounts to nothing more than I opened to your lordship as to the four leading points. I have only one word to say with regard to the Solicitor-General's suggestion that I have in my opening invented or suggested the theory that Mr. Edison carbonised after his filament or conductor was formed. I only ask your lordship to remember that I read the actual passages in his specification, and I am prepared at any time to refer to them again. The Solicitor-General said that there was not one word in Mr. Edison's specification that supported that view. I am prepared, if necessary, at any time to call attention, not only to one, but to four or five passages in Mr. Edison's specification, in every one of which he refers to carbonisation after the filament or thread is formed, and there is no single passage to the contrary. Therefore, I only want to point out before the learned Solicitor-General or Mr. Charles addresses your lordship that it is not my suggestion, but that it is Mr. Edison's description of his own invention, and it was spoken to most pointedly by Sir Frederick Bramwell and by Dr. Hopinkinson, and I think by the others too, and they were not cross-examined upon that particular point. At line 44, page 23 of the specification, Edison says: "I have discovered that even a cotton thread properly carbonised and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere offers from one hundred to five hundred ohms resistance." There the thread is spoken of as being a thread before carbonisation.

Mr. JUSTICE BUTT: I do not quite follow you on the point that the conductor was to be coiled and shaped afterwards. I do not see that the words carry that.

Sir RICHARD WEBSTER: I am quite satisfied to submit it to your lordship's judgment. Your lordship will see what I mean here. I am pointing out that he says "I take a thread properly carbonised." I say that means a thread which is carbonised, and not a thread cut out of carbon. I submit that means carbonisation after it is made. That is the point I am upon.

Mr. JUSTICE BUTT: The Solicitor-General's point was that the carbonisation there is not after the further treatment.

Sir RICHARD WEBSTER: No, my lord. Indeed it was not. The Solicitor-General's point was this, that there is nothing to show that he did carbonise before he made his thread. Now, at line 48: "If a thread be coiled as a spiral and carbonised." That is clearly carbonisation, not only after the thread is made, but after it is coiled. Now, returning to page 4, line 1: "Carbon filaments may be made by a combination of tar and lampblack." I agree for the moment it may look as though a carbon filament meant a filament of carbon. Your lordship will see it cannot be for this reason: "Carbon filaments may be made by a combination of tar and lampblack, the latter being previously ignited in a closed crucible for several hours, and afterwards moistened and kneaded until it assumes the consistency of thick putty. Small pieces of this material may be rolled out in the form of wire as small as seven one-thousandths of an inch in diameter and over a foot in length, and the same may be coated with a non-conducting, non-carbonisable substance, and wound on a bobbin or spiral"—that is, one or more times—"and the tar carbonised in a close chamber by subjecting it to a high heat, the spiral after the carbonisation retaining its form." It is utterly impossible to suggest that that is not carbonisation.

Mr. JUSTICE BUTT: The Solicitor-General did not suggest that at all. That is not what we are dealing with here.

Sir RICHARD WEBSTER: With great deference to your lordship, it is what we are dealing with here. The learned Solicitor-General said: There is no word in the specification to indicate that the carbonisation took place after the conductor was formed.

Mr. JUSTICE BUTT: Now, you are wrong there. He said except in the case of the tar compound.

Sir RICHARD WEBSTER: I will not argue it further. I will accept your lordship's correction; but it makes no difference to my mind, because I am dealing with what is suggested now, in order to prevent the patent being valid, that he indicates somewhere carbonisation before his conductor is made. I have pointed out the very passages, and my point is that not only were those passages consistent, but that there is nothing to the contrary. Now, if your lordship will look at line 22. If platinum wires are used, and the plastic lampblack and tar material be moulded round it, in the act of carbonisation there is an intimate union by combination and by pressure between the carbon and platinum. I need not remind your lordship that the platinum wires are the actual conductors up to the lamp, and in this case the carbon conductor is not carbonised until it has been put on to the platinum leads. That, therefore, shows clearly that it is shaped or formed. I am only arguing that it is brought into the condition of thread or filament in every instance before it is carbonised.

Mr. JUSTICE BUTT: I understand the Solicitor-General's point to be in effect this: I admit that in the case of that compound it becomes a thick putty, and is then rolled into a thread that is carbonised afterwards, but I say there is nothing in the patent to show that the filament used in the actual lamp was so treated.

Sir RICHARD WEBSTER: I am aware your lordship has got it in your mind that it was, and I felt that if your lordship for the moment adopted the Solicitor-General's argument I ought to point that out.

Mr. JUSTICE BUTT: I have not adopted it. I do not know how the thing stands. I have not read it carefully enough. But the suggestion is that there was a compound which he describes coming to the consistency of putty. That, says the Solicitor-General, I admit is carbonised after it assumes that shape, but I do not admit that there is anything in the specification to show that what you use in these lamps was carbonised after it assumed the shape.

Sir RICHARD WEBSTER: It is because the learned Solicitor-General has said that, that I thought it my duty to point out to your lordship that there is no passage in the specification that supports the view. It is not a question of his admitting it. It is a question of my not being able to show to your lordship that every passage in the specification is only consistent with carbonisation after the shape was formed.

Mr. JUSTICE BUTT: As I understand it, it was this: Sir Frederick Bramwell and your other witnesses laid great stress on this, that a filament was carbonised after it was made and shaped. He says there is nothing on earth in your specification to tell the public that this particular filament was carbonised afterwards and not before.

Sir RICHARD WEBSTER: Your lordship is only putting it to me. I do not know, perhaps, that I ought to have addressed your lordship on the point. I point out that the Solicitor-General, subject to what he may say afterwards, is entirely wrong. There is everything on earth, and not only is there everything on earth, but there is no passage which supports the view that you are to cut this filament out of carbon. I cannot put it more plainly than that, that you are to cut it or shape it out of a carbon.

Mr. JUSTICE BUTT: That is the distinction, no doubt, whether you make the filament of carbon, or whether you make the carbon afterwards.

Sir RICHARD WEBSTER: I hope your lordship understands I am not referring to the particular shape in which the filament is made. Now, will your lordship kindly look at line 39: "I have carbonised and used cotton and linen thread, wood splints, paper coiled in various ways." I need scarcely point out to your lordship that those are rough descriptions of the class from which he has made his conductors. In every single case, the form of the minute section has been produced before carbonisation took place. Then line 42: "If the carbon thread is liable to be distorted during carbonisation it is to be coiled between the helix of copper wire, and the helix is so fine that it may be eaten away with acid afterwards. The ends of the carbon or filament are secured to the platina leading wires by a plastic carbonisable material, and the whole placed in the carbonising chamber." Now line 51: "With substances which are not greatly distorted in carbonising they may be coated with a non-conducting, non-carbonisable substance, which allows one coil or turn of the carbon to rest upon and be supported by the other." I think I may fairly say in this short specification I have made good my point, that there is not one passage consistent with the view that the thread or filament, or conductor, of small section is to be cut out of an already carbonised material.

Mr. JUSTICE BUTT: You do not seem to me to go quite to the Solicitor-General's point. He says, unless you say in your specification clearly that this filament, of which you make so much

perhaps justly, is made of a material and carbonised afterwards——

Mr. CHARLES: Show us how to do it.

Mr. JUSTICE BUTT: And show us how to do it, then your patent does not prevail. Is it sufficient to say there is nothing consistent with that?

Sir RICHARD WEBSTER: I am not going to argue the matter now. Your lordship will understand me. I say, as your lordship has been good enough to put that point to me, assuming our evidence as it stands now is that a competent man can make this lamp, there is not a vestige of authority, and there are a number of cases which I can cite to your lordship, for saying that that kind of criticism would invalidate the patent. I say most distinctly that if a practical way of making the lamp has been shown, as it is sworn at present and not cross-examined to ——

Mr. JUSTICE BUTT: There is a case clearly, but one has to weigh the evidence.

Sir RICHARD WEBSTER: I was only dealing with the particular point which the Solicitor-General put, that in the specification there was nothing to indicate, except in the tar case, that carbonisation was to take place after the thread or filament had been formed. I am only submitting that to your lordship's judgment. I submit to your lordship's judgment that there is everything in the specification, and that to say that people may try to do it wrong, contrary to the statement in the specification, is not the construction which is ever allowed to be put upon the specification. That is the way in which the lamp would be made, and if my learned friends were going to raise this point they should have cross-examined to it. We may have to call witnesses if they attempt it now.

Mr. JUSTICE BUTT: The way in which I imagine it can be applied is this: A set of witnesses say, I have read this specification and I say that any ordinary competent workman in this line could make a lamp from that specification. That is very good evidence so far as it goes. Then witnesses are called on the other side who say, I do not think he could. Then if that is so, in order to arrive at the right conclusion as to the relative value of the evidence you must look at the thing itself to see.

Sir RICHARD WEBSTER: That is really not what I was combating. If I had thought that was in your lordship's mind I should not have had the impertinence. I was going to say a word upon it. The Solicitor-General said, this is the fallacy which Sir Richard Webster suggested; there is not a word in the patent about it. It was that your lordship might not think we aquiesced in that view.

Mr. JUSTICE BUTT: I did not think it for a moment. It was hotly contested the moment the Solicitor-General said it.

Sir RICHARD WEBSTER: I thought it might be said we had acquiesced in the view that the specification has only got this doubtful view upon it. The other matter which I have to say a word about is this: your lordship was kind enough to say that we might mention any matter that we thought of importance to your lordship, and I venture to think that it may be of importance now that I should indicate to your lordship and my friends what we say about these anticipations as a matter of law. There are 75 anticipations. I have already told your lordship we are not going to examine them in detail any more. They do not amount to anything more than the state of knowledge which I indicated to your lordship, but I must ask you to allow me to read to you what is the recognised law as to the extent of anticipation which is necessary to void a patent. It has been laid down in three leading cases, Betts *v.* Menzies, which is 10 House of Lords cases, pp. 152-4, and there are many other passages, but these are enough for my purpose; Hills *v.* Evans, in 31 Law Journal, Chancery, page 437; and Otto *v.* Linford, of which I am obliged to give your lordship the judgment. The case has frequently been cited, but unfortunately the judgment has not been reported. Betts *v.* Menzies was not new law; it was in 1857; Hills *v.* Evans was in 1861; Otto *v.* Linford was in 1882. This rule has been acted upon literally in hundreds of cases, and I am only submitting it that your lordship may have what we say is the authoritative statement as to what there must be before my learned friends can move a step to suggest anticipations. They must be able to show that a practical workman, without experiment, can produce the patented article.

Mr. JUSTICE BUTT: That the defendants, setting up the anticipations, must show that that could be done from the documents.

Sir RICHARD WEBSTER: From the document before the date of the patent, and I need not say that that has to be read with the knowledge that existed at the date of our patent and not with subsequent knowledge. No living being has ever suggested that anybody ever thought of taking Sidot's filaments and using them in an incandescent lamp of any kind, and your lordship has got to deal with the anticipations, as giving the public the information. I say there is no case in which, where a new commercial article has been produced, for the first time, it has been held that any description of the component parts of that article put together, was an anticipation of that invention. It was put by Mr. Justice Brett in those very terms.

Mr. JUSTICE BUTT: I do not follow you. That they may not take a dozen or fifty papers or lectures or specifications, and say, if we put this and that and the other together, then we produce the thing?

Sir RICHARD WEBSTER: That I say distinctly where the article is new. There have been produced two cases where patents have been held invalid, but that is where the people have produced forms of the things before, and the question was whether the patented form was anything more than a slight alteration or change from what had gone before. But at present it stands in this way, that beyond Mr. Swan's experimental lamp, which died stillborn in December, no commercial carbon incandescent lamp, no practical incandescent lamp, has ever been introduced at all; and Dr. Hopkinson's evidence is that from December, 1879, there is a complete discontinuity. Up to that time there had been nothing, and since that time there have been hundreds of thousands. Asking your lordship to understand that that is our view of the facts, I want to read Lord Westbury's statement of the law in Hills *v.* Evans, I should like to read from page 463 of the Law Journal reports. That passage was read to Lord Westbury in Betts *v.* Neilson by my learned friend Mr. Aston, and Lord Westbury then said: "By the words of the statute of James it is necessary for the validity of a patent that an invention should not have been known or used at the time. These words are held to mean not publicly known or publicly used. What amounts to public knowledge or public use is still to be ascertained. One means of imparting knowledge to the public is the publication of a book or the recording of the specification of a patent." That is what the anticipations are here, as your lordship knows. "If, therefore, in disproving that allegation which is involved in every patent that the invention was not previously known, appeal be made to an antecedently published book or specification, the question is what is the nature and extent of the information thus acquired which is necessary to disprove the novelty of the subsequent patent. There is not, I think, any other general answer that can be given to this question than this, that the information as to the alleged invention given by the prior publication must for the purpose of practical utility be equal to that given by the subsequent patent. The invention must be shown to have been before made known. Whatever, therefore, is essential to the invention must be read out of the prior publication. If specific details are necessary for the practical working and real utility of the alleged invention they must be found substantially in the prior publication. Apparent generality, or a proposition not true to its full extent, will not prejudice a subsequent statement which is limited, accurate, and gives a specific rule of practical application. The reason is manifest, because much further information, and therefore much further discovery, are required before the real truth can be extracted and embodied in a form to serve the uses of mankind. It is the difference between ore and the refined and pure metal which is extracted from it. Again, it is not, in my opinion, true in these cases to say that knowledge, and the means of obtaining knowledge, are the same. There is a great difference between them. To carry me to the place at which I wish to arrive is very different from merely putting me on the road that leads to it. There may be a latent truth in the words of a former writer, not known even to the writer himself, and it would be unreasonable to say that there is no merit in discovering and unfolding it to the world. Upon principle, therefore, I conclude that the prior knowledge of an invention to void a patent must be knowledge equal to that required to be given by a patent, namely, such knowledge as will enable the public to perceive the very discovery and to carry the invention into practical use, and this appears to be consistent with the decided cases." Then his lordship goes through them. I will not read more, but I think I, at any rate, have shown your lordship it is a clear decision in accurate general terms of what is necessary. Of course, at the end of this case, we shall contend that nothing of the kind, at present at any rate, has been shown here. Now, my lord, in the much debated gas engine case, which has since been before Mr. Justice Pearson and confirmed by a judgment of his, after the most thorough investigation, Lord Justice Brett and Lord Holker—and I may say that Lord Justice Brett paid a well-deserved tribute to the great knowledge Lord Holker had in these matters—treated the rule in a way I should like to put to your lordship, because it is 20 years after Hill v. Evans was decided. Lord Justice Brett says: "Then what is the rule when you rely only upon a description in writing as being an anticipation. It seems to me that it is not sufficient to say that if a machine were made by a person who had read that writing, something in that machine would, if it had been really a machine used, have been, by reason of that user, an anticipation of the plaintiff's patent. You must go further, and where you allege that an anticipation in writing, and in writing only, you must show that a person—I mean a person conversant with such matters—reading that writing would find in it a reasonably clear description of the plaintiff's invention in the writing alone. If it requires that a machine should be made in order that the anticipation may be seen the subsequent inventor is not obliged, when his attention is called to a mere writing, to make a machine from it in order to see what will be the effect of that machine. He has to find a description of his own invention on the face of that writing, construing that writing reasonably as an invention. Therefore, even if the defendants here could show that, with corrections suggested by Sir Frederick Bramwell, a machine were made according to Johnson's specification which would work, and if they showed that in that machine, or a part of it, the same effect as in the plantiff's machine would really and substantially take effect in their machine, yet they cannot succeed unless that working of the machine is described substantially in Johnson's specification and described so clearly that a person conversant with such things upon reading Johnson's specification carefully would say, that is a description of the plaintiff's invention."

Mr. JUSTICE BUTT: Johnson's specification was the anticipation there?

Sir RICHARD WEBSTER: Yes. "That seems to me to be the effect of the judgment in Hills *v.* Evans, and also if you apply

what was said in Betts *v.* Neilson." Lord Justice Holker said this: "The anticipation which is relied upon consists of a specification filed by Johnson. Well, the question is, not whether those letters patent have been filed, not whether those letters patent show any invention. That is not the question, but whether it describes in an intelligible way the invention of the plaintiff's. I take it to be clear that unless the specification describes the invention of the plaintiff's there is no anticipation. It seems to me there is a great difference between a specification which is relied upon as an anticipation and a machine which is relied upon as an anticipation." That is what I had in my mind when I spoke of the difference between letter-press and a new commercial article which has never been produced. "If you were to produce a machine which was made for a particular purpose, and which would accomplish when used results which were not thought of when it was made, were not anticipated, possibly the machine itself without any user would be an anticipation. I should doubt that very much myself. I do not find any authority upon it one way or the other. But I think it is perfectly clear that the machine if used so that the public could ascertain what it would effect would be an anticipation, but that is quite a different thing from producing as an anticipation a specification, for you cannot at all expect from the language of the specification what results the contemplated machine may accomplish. We have it declared in Hills *v.* Evans; it is not necessary for me to read the passage, but it is stated there as the law, and it seems very sensible, that the specification which is relied upon as the anticipation of an invention must give you the same knowledge as the specification of the invention itself. That seems a very sensible and reasonable rule. Now what do you gather from this specification of Johnson's." Then he argues it on the details of the specification, and I need not refer to that. Of course I am not at all suggesting that you are not honestly to take, if necessary, two documents which are public knowledge and put them together if they indicate discussion or invention or discovery in the same line, but you are not to piece together parts which are now found to be useful, which were never intended to be put in combination before for the purpose of building up a combination which has never in fact even existed or been described prior to the time that the patentee had disclosed his invention. In Van Heyden *v.* Newstadt, Lord Justice James said: "No mosaic construction of prior documents can be used so as to set up an anticipation." I do not put it so epigrammatically as that in my observations. I am not going to transgress the rule I laid down for myself. Betts *v.* Neilson is in the Law Reports, 5, House of Lords, page 15. There your lordship will find Lord Westbury repeated and re-enunciated what he had said in Hills *v.* Evans. It will fall to my learned friend Mr. Aston, or to one of the counsel for the plaintiffs, to address your lordship at the conclusion of the defendants' evidence. I submit, at present, that I have sufficiently brought to your lordship's attention the propositions of law that are necessary in support of our view of the case.

(To be continued.)

THE INCANDESCENT LAMP PATENT CASE.

(*Continued from page* 540.)

SECOND ACTION.

WE have then examined the legal aspect of the first action. Difficult as it is to form an accurate opinion on it, the second action will be found, we think, more troublesome still. The action was brought to restrain the defendants from performing the operation known as "flashing"—that is, of heating the filament with the electric current while immersed in a hydro-carbon atmosphere.

The patent sued upon was Cheesbrough's, 4,847, 1878, being a communication from Sawyer and Man of America. When first taken out the patent was undoubtedly void, inasmuch as out of the 29 claims in it, 25 had been previously published in England, by the depositing in the Patent Office of a copy of an American patent for the same matter, and by the same persons. This defect was afterwards remedied by disclaimer. As amended, the patent commences by stating that its object is "the production of an improved electric lamp, and the production of a better carbon for the use of electric lamps." It then points out that imperfection in vacua had been up to that time the reason why no lamp had been practically operative. After describing a lamp (which, by the way, appears to be remarkably like one patented by Kosloff in 1875, and which consisted of an incandescent rod of carbon in a bell jar of nitrogen), he goes on to describe a method of making carbons for incandescent lighting. "It has been found," he says, "that a pencil of carbon immersed in a hydro-carbon gas or liquid, and heated to an extremely high temperature by the voltaic current, is not itself attacked but decomposes the surrounding matter, the carbon of which enters and fills up its pores to an extent impossible except with matter in a very attenuated state, and deposits a perfectly homogeneous layer, generally of a bright grey colour, upon the exterior surface. As the carbon increases, more current is required to maintain its temperature, and if the current is gradually increased in accordance with the demand for it, there is, appearingly, no limit to the increase in mass of the homogeneous exterior deposit. Carbon pencils may be cut from the deposit, or the original pencil with its coating may be used in the lamps.

"In this process it will be seen that the carbon is never in contact with the liquid in which it is immersed, but surrounded with a carbonic gas of very high temperature, beeswax, balsam, and most oils if pure operate satisfactorily, almost any hydro-carbon in fact will answer. . . . . The before-going is a descriptive method of charging a sealed globe with pure nitrogen gas, let it be supposed that the pencil of carbon held between two carbon pieces of greater mass than that of the pencil above described, is immersed in the hydro-carbon liquid and heated in the manner already described, being then cleansed in alcohol, the pencil and its holders without having been disturbed are placed in the globe in which they are to be hermetically sealed."

The inventor then says: "I do not claim the construction of the lamp hereinbefore described, but what I do claim is, *first*, the hereinbefore described method of preparing the illuminating part of an electric lamp, consisting of electrically heating the same while it is surrounded by a carbon gas or liquid.

"*Second*, a material for the manufacture of the illuminating conductors of electric lamps produced by electrically heating carbon in a carbon gas."

At the trial it was apparently admitted that the defendants flashed their filaments electrically in a hydro-carbon gas or liquid.

Now it will be noticed that there are several curious points about this patent. In the first place the inventor, after describing the use of a hydro-carbon, claims a "carbon" gas. But carbon gases, such as carbonic acid or carbonic oxide, will not do. So that to make his claim good we must probably read "carbon" gas as if it were "hydro-carbon gas"—a rather strained reading, for the only other way of supporting the patent would be to read it "any carbon gas that will do"—but such a reading as this could surely never be sustained. In the next place it is to be noticed that the first claim claims "The hereinbefore described method"—but on turning to the description we find that it specifically treats of a particular method of flashing, so as to cement the carbon pencil to its carbon holding-blocks—a method not used by any one now. The next claim is for the material as a material for the manufacture of incandescent lamps.

The chief defence raised at the trial was that the second claim was old. The instances alleged were, firstly, a discovery of the celebrated chemist Despretz. In his endeavour to melt carbon, the most refractory substance known, Despretz was led to heat it by a very powerful battery, placing it in a lamp with as good a vacuum as he could obtain, and also in various gases. Fearing still that the carbon, instead of melting, might be dissolved or dissipated through the action of the surrounding media or gases, he hit upon the idea of using as a surrounding medium a gas already rich in carbon, and which was hence not likely to desire any more. Here appeared the unexpected result that the carbon became gray, springy, and metallic, and had all the characteristics of Sawyer and Man's carbon.

Some years after this, M. Sidot proposed a new method of making carbon, by heating, by means of a fire, wood, threads, and such like vegetable matters, placed in a porcelain tube, and surrounded with

vapour of disulphide of carbon (which is not a hydro-carbon), and he also mentioned various forms of hydro-carbon as suitable for this purpose. He, too, noticed the elastic, metallic character of the product, for he even made a sonorous bell out of such carbonised wood, and suggested it as a useful substance for the carbons of electric lamps.

On these facts it was argued that at least the *material* was old, and that therefore the second claim was bad.

In his judgment the judge dealt with the various points that had been raised in succession; he then went on to say that "in using the words hydro-carbon gas, the patentee clearly could not have meant what chemists understand by a hydro-carbon gas (*i.e.*, a gas consisting only of carbon and hydrogen); that is clearly not what he was referring to, ... but it is said 'well, but (if you do not read it as meaning hydro-carbon gas) you will be including some gases, as carbonic acid and carbonic oxide, which, if applied, would not produce the result at all.' . . . . . If the specification is really to be read as a direction to the public to use either one of those gases, then I shall agree that the process described is a futile one . . . . . I really do not think he meant that . . . . . he has used the expressions hydro-carbon gas, carbon gas and carbonic gas. From the evidence I say I do not think he meant exactly what he said in using any of these expressions;" and his lordship then went on to say that he had come to the conclusion that anyone would know that carbonic acid and carbonic oxide gases would not do. But here we have a right to demand "if the patentee meant none of these things and did not mean what he said, then what did he mean?" It is a new thing in patent law that we are to go behind what a man says, and confirm his patent to him for what he "meant," on the ground that he did not mean what he said; but it is newer still to do this when at the very same time you confess your inability to say what he did mean! If he meant hydro-carbons according to the usual acceptation of the word, then beeswax is not a hydro-carbon, nor is carbon disulphide—if he meant carbon or carbonic gases, then numbers of them will not do. This part of the case still seems to rest in the greatest confusion, and it is greatly to be hoped that on appeal the Court will really determine what the patentee did say and what he is to be taken to have said, so that the public may clearly know what the patent is really for.

As to Sidot's process, the judge decided that it would not produce a material similar to that of Cheesbrough's. In this he differed from some of the plaintiffs' witnesses, who admitted that it would. The reason he gives for his opinion is, that by Sidot's process you apply external or furnace heat, thus producing uniformity of heat, which in its turn produces "uniformity of deposition per unit of surface, and that is just what you do not want in your process for producing the carbon conductor described by Mr. Cheesbrough." As to the anticipation of Despretz his lordship says: "There is one most important object obtained by the process patented by Mr. Cheesbrough which I think the defendants have failed to show that Despretz's process would yield. The principal object of this patent is to ensure the filling up in the course of the treatment of the pores of the carbon, the porosity of ordinary carbon being a serious objection to its use in incandescent lighting. Now one part of the process described is the gradual increase of the electric current. This was certainly no part of Despretz's process; it is an important matter. All, or nearly all, the witnesses have referred to it as a matter of significance, and Prof. Dewar's evidence on this point is as follows:—'He' (that is, the patentee) 'also points out the advantage of a gradual increase in the intensity of the current. For Cheesbrough's purposes you must have an intense electric current increased from a less intense one.'" Now with every respect we are fairly entitled to ask the reader to look back at the words of the patent printed above and see where the necessity of such gradual increase is pointed out? What Cheesbrough says is, that "*If* the current is gradually increased there is apparently no limit to the increase of the homogeneous exterior deposit"—and that, not for the reason that any gradual increase of current is needed to form the substance, but simply (as Cheesbrough says, and every electrician knows) that "as the carbon increases more current is needed to maintain its temperature," and he then goes on to suggest the cutting of carbon pencils out of the deposit so formed.

This is the most difficult point to understand in the whole judgment, for here again Cheesbrough appears to have been made to invent something that he certainly does not appear to have discovered, nor in words to have pointed out.

His lordship further pointed out that even if he had not adopted this view, that then even if Despretz process had really anticipated Cheesbrough's material, it is very doubtful whether it would, unused as it was, have been really a true anticipation.

Here, then, we have the grounds upon which the decision proceeded, stated as fairly as the difficult and complicated nature of the case seems to allow. Should the patent be upheld by the Court of Appeal, doubtless some definitions will be given of what is really covered by it, so that if it is restricted, as it probably must be to some form of hydro-carbon, expert chemists may use their ingenuity in discovering some substance outside the pale of the hydro-carbon as limited by the courts, and by the aid of which the flashing process may be successfully performed.

THE ETEVE-HUMES PETROLEUM ENGINE FOR LAUNCHES.

THIS engine is of the vertical type with cylinder uppermost, having the crank shaft in line with the keel of the boat, and is provided with a fly-wheel 2 feet 6 inches in diameter. The floor space occupied is about 2 feet 6 inches square; oil tanks, mixers and other parts unconnected with the gearing are stowed under the seats or thwarts.

The cylinder is jacketed with a water chamber, through which water is constantly being pumped, entering at the lower end of the cylinder and passing away from the upper end; the reason for this apparent reversal of the water supply, that is, in not pumping the fresh water on to the hottest part of the metal, was to ensure the certainty of the water chamber being always full, the constant change secured in equal quantities for each stroke of the pump thereby counteracting any disadvantage that might otherwise arise from this method of supplying the fresh liquid.

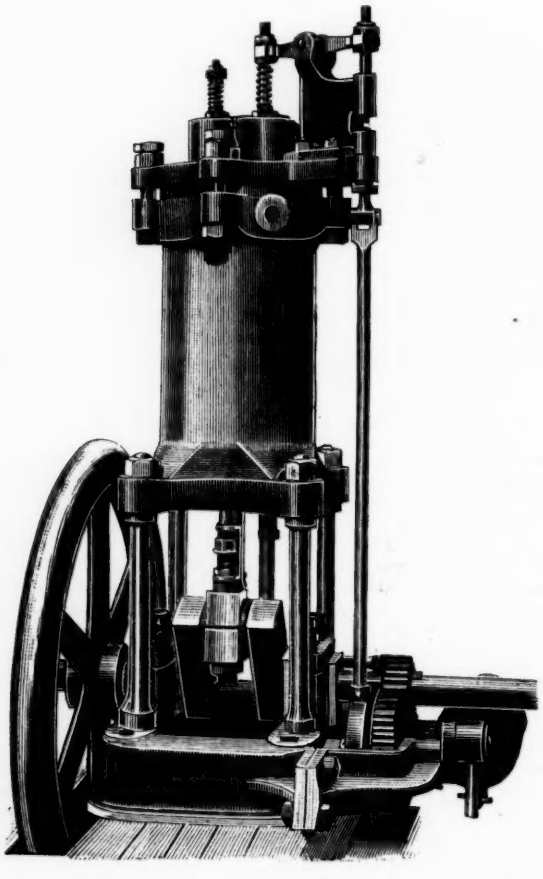
To the top end of the cylinder are attached two valves, one to regulate the exhaust of the burnt products of each explosion which is worked from the eccentric, and the second acting automatically, furnishing the supply of petroleum spray.

The eccentric is carried on a separate shaft, and by means of toothed wheels is revolved at half the speed of the crank shaft; this shaft also actuates the air pump as well as carrying an arm which puts on the electric current when required to ignite a charge in the cylinder. The eccentric rod is connected to a slide rod which during a portion of the stroke presses and lifts another sliding rod, thus opening the exhaust valve and the returning piston frees the interior of the cylinder from spent gases.

The automatic valve for gas supply begins to work when the piston begins its forward stroke, but as soon as the compression takes place on the piston's return, the valve is closed, and on completion of the compression the charge is ignited by the spark from an induction coil, the explosion driving the piston forward, and the succession of processes repeating itself. There is consequently one ignition for every two revolutions of the main shaft.

The air pump, as mentioned above, is worked from the eccentric shaft, forcing the compressed air

through a tube to the oil tank, passing a regulating valve which it is proposed to adjust by means of the engine governor; the air supply and the fine jet of petroleum are then mixed in a receptacle, again passing through a chamber filled with lengths of iron wire, and from thence proceeding to the cylinder cover to be admitted through the automatic valve when a charge is taken. The chamber filled with iron wire is to prevent any danger from back lash of the flame, which might perchance reach the mixing chamber and cause an explosion.



The power given out by the engine is about 3½ H.P. actual, with a consumption of about one quart per horse-power, costing, say, three-halfpence for oil.

The arrangements for lubrication appear to be satisfactory, and the device for reversing the engine is neatly and skilfully arranged.

Taking the engine as a whole, the makers have made immense strides in the improvement of every part of it during the last year, and the friction throughout the working parts has been reduced to a minimum.

The Electric Light at Eastbourne.—At the last meeting of the Eastbourne Town Council a recommendation was brought up from one of the committees to the effect that the electric light should be adopted throughout the whole of the new Town Hall (a sufficient number of gas brackets being provided in case of emergency), and that the architect should be requested to bring up an estimate and a report on the matter. Councillor Hillman asked whether the Brighton Town Council had not decided to abandon the electric light in the Pavilion. Possibly a little information on this subject might influence the council in regard to the method of lighting the new Town Hall. As no member of the council seemed to be in a position to answer the question, the matter was referred back to the committee.

NOTES.

Electric Lighting at the Edinburgh Exhibition.—A Correction.—By inadvertence we published last week an article, extracted from the *Times*, on the electric lighting machinery and apparatus at the Edinburgh Exhibition, under the heading of "Electric Lighting at the Liverpool Exhibition." As we have previously stated, the whole of the electric lighting at the Liverpool Exhibition is being carried out by the Liverpool Electric Supply Company, of which company Messrs. Holmes and Vaudray are the managing engineers.

Electric Lighting on Railways.—According to the *Engineer*, some engineers still speak of electric lighting as untrustworthy. One railway engineer recently refused to light an underground railway by this light, chiefly because of its uncertainty, but another railway engineer is not only lighting Paddington Station, one of the largest in London, but he is lighting all the signals by the same means, the strongest possible proof of the reliance some men put in electric lighting, and this even with an alternating current. An underground line is just the place where gas should not be used, but the engineer of the Mersey line laid great stress on the higher cost of the electric light. When railway signals are properly lighted by electricity they may be also worked by the same means.

Town Lighting by Electricity in Sweden.—The first city in Europe where electricity has been entirely substituted for gas for street lighting is the town of Hernösand, in Sweden, where the Thomson-Houston system has just been adopted. The motive power is water, which is very plentiful there, rendering the light cheaper than gas.

The Telephone in Swansea.—We understand that next week the Western Counties and South Wales Telephone Company will open a telephone exchange in Swansea, having secured convenient premises at the bottom of Wind Street in proximity to the docks and merchants' offices. There will be direct communication with Llanelly at once, and within a short time, the new company's wires will extend to Landore, Neath, Aberdare, and thence through Newport, we believe, to Bristol. The Swansea Commercial Exchange is intended to be open both night and day, Sundays excepted.

Telephonic Communication at Bath.—The Western Counties and South Wales Telephone Company having decided to open a telephone exchange in Bath, a trial line was erected last week between two well-known houses of business, and messages were conveyed to and fro with great success. The centre of the exchange will be situate in Union Street. Already many applications for membership have been received, and, by the opening date—definitely fixed for the 21st inst.—doubtless many other commercial men will take advantage of such a desirable means of inter-communication.

Mexican Telegraphs.—We gather from official reports that notable improvements have taken place in the management and working of the Mexican lines under the energetic control of the Director-General of Federal Telegraphs, Senor C. Saturnino Islas, ably assisted in his endeavours to improve the service by Senor C. Ortiz, the chief of the Central Office, and by Senor Carlos J. Bustamente, inspector of the 4th Department. The efforts of these gentlemen have been lately directed towards the improvement of communications between Paso del Norte on the United States frontier, and Vera Cruz on the Gulf of Mexico, a distance of about 1,836 miles, and they have succeeded in working between those two places in the most satisfactory manner. When one considers the great distances of uninhabited country the lines pass through, the difficulties of transport, the scarcity of skilled labour, and the severity of tropical storms, the fact that not only

has good communication been established but has also been maintained, reflects great credit on those who have carried out the work. The average time occupied in the transmission of messages between Paso del Norte and Vera Cruz is about 50 minutes per message. The Mexican Government could not have made a better selection than Senor Islas as Director-General of Telegraphs, for it is certainly due to his zeal and energy that a general reform (and one much needed) has been effected throughout the whole of the Mexican telegraph system. He has had many difficulties to struggle with ; jealousies, want of money and material, inefficient operators, and the proverbial Spanish "manana," have all contributed to delay his work, but he has succeeded in overcoming most of the obstacles which hindered the efficient working and delayed the extension of the lines under his charge.

French Telegraphs.—The French papers state that Mons. Fribourg, director of construction in the Ministry of Posts and Telegraphs, has been appointed as Government Delegate to assist the Minister of Posts and Telegraphs before the Chamber of Deputies and the Senate in support of the Bill approving of the telegraph laws and tariffs drawn up at the Berlin Conference of September 17th, 1885.

Telegraph Instruments Wanted.—The Highland Railway Company advertises for tenders for telegraph instruments and fittings, to be lodged with the secretary, Mr. A. Dougall, company's offices, Inverness, by the 26th inst.

Telegraph Revenue.—The receipts on the telegraph service from April 1st to June 12th, 1886, amounted to £265,000 against £355,000 received from April 1st to June 13th, 1885. The estimated receipts for the year 1886–7 are £1,730,000.

The International Cable Company.—According to the *Financial News* : "The International Cable Company, Limited, or their agents, are circulating in various cities on the Continent a circular letter, written in French, strongly recommending the enterprise to continental investors. According to this document the capital of the company is £1,000,000, 'of which £500,000 has already been subscribed in England, half by the Henley's Telegraph Company and half by the syndicate of Alfred Huth and others.' According to the same document, 'the banks which, after minute investigations of the merits of the enterprise and of the character of the persons connected with it, have undertaken to make the issue of shares in England and on the Continent are : Messrs. Dimsdale, Fowler & Co., of London ; Parr's Banking Company of Liverpool ; the Union Bank of Manchester, with its 36 branches ; Henry Burnay & Co., of Lisbon ; J. Matthieu et fils, of Brussels ; and Baron Oppenheim, of Cologne.' 'All these bankers,' we are told, 'are prepared to confirm the favourable statements made concerning the enterprise.' . . . . The names of the trustees (*commissaires*) are given as 'Sir Robert Fowler, Baronet, M.P., former Lord Mayor of London,' and 'Charles Seymour Grenfell, director of the London and County Bank,' while the names of the electrical engineers are given as 'Dr. Hopkinson, engineer of the Board of Trade and of Trinity House, and M. Massey, Windsor Castle, electrician of the royal palaces.' . . . . With this array of names it should not be difficult for the company to obtain in Belgium the £150,000 of subscriptions which the circular before us says must be subscribed firm before any issue is made (*on demande a la Belgique de souscrire ferme avant toute emission pour* £150,000). But it would be interesting to know why, if £500,000 has already been subscribed in England, 150,000 *must* be forthcoming from Belgium. According to a 'private and confidential' prospectus of the company, written in English, and from which, by-the-bye, the names of the directors are conspicuously absent, the first issue will only be of £650,000, or just the amount already reported to have been subscribed by the Henley Company and Mr. Huth, *plus* the amount asked from Belgium. Our Belgian friends and all intending investors should look into this matter carefully before investing, more particularly because the company's English prospectus sets forth that 'applicants for shares shall be deemed to have waived *all* rights under the 38th section of the Companies Acts, 1867,' rather an important waiver. It would also be interesting to know who the parties are behind the distinguished directors and engineers whose names are so temptingly paraded in the French prospectus. Were they in any way connected with the late A B C Cable Company, or with Mr. Otto Rochs, or with Messrs. Macpherson & Co. ? and why has it been deemed expedient to solicit subscriptions abroad before the floating of the company in England ? "

Alleged Libel on Mr. Hugh Watt.—Richard Fyfe, engineer, was charged at Westminster with writing and publishing a false and defamatory libel of and concerning Mr. Hugh Watt, merchant, of St. George's Road, S.W., and one of the members of Parliament for the city of Glasgow. The prosecutor was not in attendance, but his sworn information on which the prisoner had been remanded was read over by Mr. Safford, the chief clerk. It was to the effect that on March 20th last the prisoner was discharged from the employment of the Maxim-Weston Electric Company, Limited, of which Mr. Watt is the chairman of directors. Since his discharge the prisoner has written a number of most scurrilous letters, which had been sent to Mr. Watt. His friends had also received letters of a like character, reflecting upon him in various capacities as regarded his directorship and in his private life. He identified the writing of the matter alleged to be libellous as that of the defendant. Copies of the letters, with the words "to be published verbatim," "to be forwarded to your constituency, brother directors, shareholders," &c., were in the following terms : "H. Watt. Sir,—I was never kicked out of my house and my wife gone ; the brokers in charge of a house on the hire system. I am a gentleman—Richard Fyfe. . . . . You will very likely pay my claim in course. £62,500. Office boys."—Mr. D'Eyncourt remarked that he did not understand this.—The Chief Clerk : The suggestion, I believe, is, Sir, that shares were awarded to office boys to that amount. These letters were sent to Mr. Watt's brother directors.—Serjeant Edwards, who arrested the prisoner on the first occasion, stated that when in custody he said he could prove what he said, and that the prosecutor had written him a letter threatening him with penal servitude. Fyfe also told him that he went to Glasgow at the time of the last election, and was there for six weeks, at great expense to himself, assisting in Mr. Watt's candidature.—Dengate, one of the warrant officers, who took the prisoner in custody on Saturday night, at a public-house at Chelsea, where his wife had been followed, said that he made a statement to the effect that it was very foolish on his part to go away ; it was due to the fact that he went on the drink.—Mr. D'Eyncourt remanded the accused in custody for the attendance of the prosecutor.

Another Searcher Rewarded.—Mr. A. Moulds, residing in Upper Kent Street, Leicester, perceiving an escape of gas in one of the rooms in his house, took a light to search for it. The result was that a serious explosion occurred, the doors and windows were blown out into the street, the furniture wrecked, and the walls stripped of their coverings. Mr. Moulds was knocked down and severely shaken.

The Meaning of "Filament."—In some works on hydro-dynamics the word filament is applied to a jet of water. The scientific experts who were under examination during the recent incandescent lamp patent case may like to know this fact, as it contradicts the assertions of some of the plaintiffs' witnesses that the word is never used except with reference to something exceedingly fine.

Patent Office Library.—The free library at the Patent Office, Southampton Buildings, will after July 1st be opened from 10 a.m. till 10 p.m.

Examination Papers.—We have perused the examination questions for 1886 in magnetism and electricity, set by the Science and Art Department, as well as those for telegraphy, electric lighting and transmission of power, and electrical instrument making, prepared for the students of the City and Guilds of London Institute. There has been an immense improvement in the electricity-magnetism papers during the last two years; all the examples in the Elementary and Advanced Grades are little problems, not mere stock questions. In telegraphy Mr. Preece tries to be very concise, but junior telegraphists must find it very difficult to answer the Ordinary Grade questions, the range of subjects being too wide to expect an answer to 10 out of 12. The other papers mentioned also show an advance generally upon those of previous years, Dr. Fleming now being examiner. That on electrical instrument making is the least satisfactory, and we should be inclined to say that the propounder of the questions had never worked as an instrument maker, for he does not bring out the niceties of the trade. Examiners should do their very utmost to set questions in the Ordinary Grade suitable to workmen and apprentices. In the Honours paper they may ask any questions however difficult, and especially questions which will show that the student, who is not supposed to be a mere workman, has read and understood electrical literature.

Ballaarat School of Mines.—The report for 1885 of the lecturer on electricity and magnetism at these schools, Mr. Henry Sutton, A.S.T.E., states that during the year satisfactory progress has been made, the students devcting a considerable amount of application to their work. The method of study has been somewhat modified during the past year. Students spending six months in the elementary theoretical portion of the subject and the easier branches of practical work, are then considered fit for trial in first stage examinations; if successful, they complete a course of six months at practical work, and another six months principally in the study of the applications and more advanced theory, which enables them, if successful, to pass the second stage. The practical work performed during the first half of the second stage year consists in the manufacture of electrical testing apparatus, which becomes the property of the student, and is used by him in his subsequent work. The final examination requires twelve months hard study and work before the student is considered fit to present for the school's certificate; so that it takes two years and six months for a student, if successful at every examination, to be considered qualified as an electrician. The lecturer on telegraphy, Mr. W. D. Campbell, reported that the attendance in his class had kept up very well during the year, 65 names appearing on the roll. The result, however, of the two examinations held, had been very disappointing, only four students having passed. This was unprecedented, and seemed to point to a raising of the standard by the examiners, which would have to be met by greater care, if possible, in preparing students; greater diligence on their part; increased facilities being offered for practice; and probably a longer period of tuition, before being allowed to present for examination. The increased difficulty of passing should not, however, deter students as there is likely to be an increased demand for operators, caused by the expansion of the telegraph system by the reduction in the price of telegrams.

Conversazione. — Prof. D. E. Hughes and Mrs. Hughes have invited the members of the Society of Telegraph-Engineers and Electricians, of which society the Professor is president, to a conversazione in the galleries of the Royal Institute of Painters in Water Colours, 191, Piccadilly, on Tuesday evening, the 29th inst.

New Chloride of Silver Battery.—Mr. Warren de la Rue, *Engineering* states, has arranged his chloride of silver battery in a new or dry form, which adapts it better for the purpose of maintaining small incandescence lamps alight. The cell consists of a flat glazed earthenware tray containing a sheet of silver foil on its floor. Dry powdered chloride of silver is spread over this plate, and a vegetable jelly is laid over that to support the zinc plate, which is the upper pole of the cell. This jelly is made by dissolving a solution of chloride of ammonium (2½ per cent. of the salt) in Ceylon moss or "Agar-agar." A pile of these cells makes a small convenient battery.

Electrical Boats for Service.—In the *Army and Navy Gazette* for the 12th inst. there commenced the first of a series of articles having the above title. The author is Mr. C. Sleeman (late R.N.), and we make the following extract from his paper:—"Insomuch as a great many of our men-of-war are being now provided with the electric light, and as it is intended to introduce this system of lighting throughout the service, the means for the recharging of accumulators is ready to hand, and thus many of our ships-of-war are pre-eminently adapted for the employment of electrical boats; while as, in addition, there is to be found at most of our naval ports machinery of the right description for executing the work of recharging, there really exists no adequate reason why, for once, the Admiralty should not take the initial step, by instituting experiments on a reasonable scale, to work into practical shape a new application that, as in the particular case under notice, offers every reasonable prospect of ultimately proving an immense boon and benefit to the service at large." We fear the writer does not understand the kind of machine which is always employed for charging accumulators or he would not say generally that the means (on board ship) are ready to hand.

Honours for an Electrician.—In recognition of the great advance exhibited in Mr. Lucius J. Phelps's method of communicating telegraphically with moving trains, the Franklin Institute has awarded to that gentleman the John Scott Medal and Prize. Some time since a special committee appointed for the purpose examined the system fully, as it is operated on the New York and New Haven Railroad, and upon their recommendation the award was made. Mr. Phelps has introduced numerous improvements by which he duplexes his line, thus adding greatly to its capacity.

A Heartless Inventor.—Mr. Hussey, of Menlo Park, has invented an electrical clock that runs without winding. The man who generally becomes thirsty about midnight, and invents an excuse to go down stairs by saying that he forgot to wind the clock, will not give a cordial welcome to the new timepiece.—*Norristown Herald.*

The Life of Incandescent Lamps. — Mr. James Swinburne finds that if lamps of 100 volts and 50 volts, of any makers, are both overrun on the same circuit at the same efficiency, the 100 volt lamp breaks first. With regard to the question of the life of lamps, Mr. Mordey shares the common belief that it is of the utmost importance that lamps should have long lives. He holds this opinion in spite of Mr. Preece's statement, that at present lamps last too long, and that it would be better to work them at a higher efficiency and with a shorter life.

High Tension Currents.—At Eastbourne, for nearly 3½ years, there have been two circuits running with 1,800 volts on them every evening, and during the whole of that time there has not been a single accident; and, with the exception of Mr. Henry M. Sayers, no one has yet received a shock. One evening this gentleman was making some experiments and managed to break the 1,800 volt circuit and put himself in the gap. Although knocked down he received no serious hurt.

The Emission of Light.—Mr. Mortimer Evans thinks that the economy of light and the absence of heat emitted from an incandescent surface is solely due to the reflective efficiency of the surface itself, and not in any way to the material of which it is composed. Were we able, says Mr. Evans, to produce a perfectly reflecting carbon surface, or, indeed, a perfectly reflecting surface of any material capable of bearing the necessary temperature, I have little doubt but that an efficiency of 1½ or 2 watts per candle-power might be obtained, and this without any increase in the temperature or strain to the filament.

Rupture of Insulating Materials.—Mr. Mordey does not think that Prof. Fleming is right in supposing that the danger of rupture to insulating materials increases as the square of the electromotive force. Mr. Mordey's own experience in practical working has never revealed anything that would confirm such a supposition. We imagine not, for if our memory serves us aright, Prof. Ayrton has employed no less than 14,000 volts in testing some of Henley's patent ozokerited India-rubber core.

The Unseen Agent.—Sir David Salomons relates the following story, but does not guarantee the whole of the particulars as being accurate; but generally the facts are true :—There is a shop a few doors from the Inns of Court Hotel lighted by arc lamps. A man went to look into the window of the shop and was suddenly knocked down by some unseen agent; a policeman thereupon went to complain to the manager inside, but he was knocked over likewise. The reason of all the mischief was that the whole of the framing of the shop was of metal, also the area frame in front, and one of the arc lamp leads had somehow become connected with the framing.

Carbon Conductors in Glow Lamps.—Prof. Silvanus Thompson expresses astonishment that Mr. Preece should call the Bernstein carbon tube a "filament." Some one, says Mr. Thompson, at some time coined the term "filament," which may be convenient when one is speaking of a thin shred of tarred fibre, carbonised; but the name having been invented, we have all, like silly sheep, followed the fashion of calling all carbon conductors inside lamps "filaments," whether they really were or not.

The Bernstein Lamps.—Professor Ayrton thinks there is one great use for these low resistance lamps, and that is for temporary installations. A person wants to know, for instance, how many accumulators will be necessary for use with, say, half a dozen incandescent lamps of the ordinary type. The answer will probably be 26. But with the Bernstein lamp one could reply "four accumulators," and the Professor knows that such an answer will lead to the use of incandescent lamps for temporary installations.

The Regulation of Electric Currents.—At the meeting of the Society of Telegraph Engineers and Electricians on March 25th, Mr. Crompton said :—"I wish to point out that Profs. Forbes, Ayrton, and Silvanus Thompson have all fallen into the same error in ascribing the very perfect constant current regulation of various American systems of arc lighting, to regulating apparatus alone. They appear to have forgotten that in systems of arc lighting in series every arc light is a current regulator in itself, and this fact alone enormously facilitates the work of regulation of the governor or regulator common to the whole series system."

Wire Gauges.—Messrs. Walter T. Glover & Co. have recently improved their standard wire gauge to such an extent that we shall have something to say respecting it in our next issue.

Constant Currents.—During the discussion on Mr. Bernstein's paper, recently read before the Society of Telegraph Engineers and Electricians, some doubts were expressed as to the possibility of getting a constant current for electric lighting. Mr. Wright said that it was perfectly practicable, and that it was done at Brighton every day over three or four circuits extending some 8½ miles.

The Etéve Petroleum Motor.—This engine, which is illustrated in our other columns, has been spoken of on several occasions in the REVIEW. We can, from our personal knowledge of its working, speak in very high terms of its utility, and our only wonder is that it has been so long in making its way in public favour.

Foreign Telegrams.—The Postmaster-General has given notice that on and from the 1st prox. the new regulations respecting foreign telegrams agreed upon at the International Telegraph Conference held at Berlin will come into force. The principal alterations are the following :—(*a*) The rules relating to European have been assimilated to those relating to extra-European code telegrams, the limit of length of a word in such messages being fixed at 10 letters, and words drawn from more than one of the authorised languages, viz.—English, French, German, Italian, Dutch, Portuguese, Spanish, and Latin being allowed. (*b*) The names of both the office and the country of destination will be counted in the address as one word each, whatever their length, provided they are written as single words by the sender, and are spelt in accordance with the official list. (*c*) The sender of a telegram will be able to have it repeated from office to office during transmission by paying an additional quarter-rate, instead of a half-rate as at present. (*d*) If the sender of a European telegram prepays a reply and the reply form is not used by the addressee, the amount prepaid for a reply will not be refunded as hitherto. (*e*) If the addressee of a telegram has it repeated and it then proves that only a portion of the telegram was inaccurately transmitted, only a proportionate part of the charges will be refunded. (*f*) The charges for any word or words omitted during the transmission of an extra-European telegram will be refunded. (*g*) The rates to several countries will be reduced as may be seen on reference to the Post Office Guide for July. The following are a few examples :—Russia, from 9d. to 6½d.; Spain, from 6d. to 4½d.; Italy, from 5d. to 4½d.; and India, from 4s. 7d. to 4s.

The Sonnblick Observatory.—What will be the highest observatory in Europe is now being erected on the Sonnblick, one of the heights of the Tyrolese Alps, 10,000 feet high. As there is great danger to the building from the terrific thunderstorms which rage round the summit, the observatory is protected not only by three lightning rods, but also by a lightning-proof fencing. The solitary resident observer who has chosen to exile himself from civilsation for the best part of the year is one of the miners permanently residing in the miners' house 8,000 feet above sea level, who is now undergoing a course of instruction in meteorology. But he will not be cut off entirely from intercourse with his kindred, for he will be able to keep up communication by telephone with the miners' house 2,000 feet below him, whence another telephone wire, 15 miles long, leads to Rauris. From the latter place, his daily record of observations will be telegraphed to Vienna and the scientific world generally.

Fire Damp Indicators.—We hope in our next issue to be able to describe an arrangement by which electric incandescent lamps may not only be employed for lighting purposes in mines, but may also be used as fire damp indicators. This, we think, has not hitherto been thought practicable.

Primary Batteries for Incandescent Lighting.—The following letter from Mr. Allan V. Garratt to the New York *Electrical Review* is in reply to the letter of Messrs. Laing, Wharton and Down, which appeared in our last issue. Mr. Garratt says :—"I would say that the statements therein made are not sufficiently lucid to enable me to make an intelligent comparison of the cost of producing the incandescent light from primary batteries here in America, as compared with the cost in England. If I am to understand that the above-named gentlemen can charge a primary battery, which will maintain 12 to 15 eight candle-power lamps for 210 hours at a cost, for solution, of only one dollar and a quarter, and consume only 25 cents worth of zinc, I am sure that readers of the *Review* will be pleased to read a detailed description of how it is done. If, on the contrary, they can produce 8 candle-power of light for 210 hours at a cost of one dollar and a half, that is quite a different question. If Messrs. Laing, Wharton and Down will kindly publish in the *Review* a more detailed estimate of the cost of incandescent light by their system (stating the cost to their customers) I will be pleased to reciprocate by stating the price of light by the Volta Pavia system of the Chemical Electrical Light and Power Company of this city."

NEW COMPANIES REGISTERED.

Bradford Mutual Electric Lighting Company, Limited.—Capital, £10,000 in £5 shares. Objects: To enable the holders and tenants of premises abutting upon Kirkgate, Ivegate, New Tyrrell Street, Hustlergate, Albion Court, Queensgate, and other detached blocks of buildings in Bradford, to co-operate in using the electric light. Signatories (with 1 share each), Edward Pye, J. F. Schmidt, J. Mairom, Captain Oscar Haake, J. F. Read, F. T. Schmidt (electrician), R. C. Douglass (engineer), all of Bradford. Registered 10th inst. without articles of association by Messrs. Cann and Son, of 18 and 19, Fenchurch Street, as agents for Mr. F. McGowen, of Bradford.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Standard Time and Telephone Company, Limited.—A meeting of the shareholders in this company was held on the 5th inst., when an account was laid before them, showing the manner in which the winding up of the company has been conducted and its property disposed. The Registrar of Joint Stock Companies was duly informed of this meeting having taken place by the liquidator (Mr. Edgar Ray), on the 8th inst.

Cordner, Allen and Company, Limited.—At an extraordinary meeting of the shareholders in this company held at 20, Bucklersbury, on the 21st April, the following special resolutions were passed :—"In article 5, line 1, the word 'may' shall be substituted for the words 'shall not.'" "That to the extent of any shares of the company which shall become the property of the company, whether by purchase, or surrender, or forfeiture, or otherwise, the directors are authorised to issue in lieu thereof new shares having preference or guaranteed dividends, or profits, or any preference or priority, as regards the capital, dividends, or profits, or both, over the shares in the existing capital, or such other special rights, privileges, priorities, or advantages as the directors may think fit." "That the name of the company be changed to 'The Stanhope Company, Limited.'" These resolutions were confirmed on the 7th ult., and were registered 8th ult. A letter from the Board of Trade dated 14th May, and filed on the 22nd May, sanctions the change of name.

The last return of the company, made up to 13th January, was filed on the 24th March. The nominal capital is £30,000 in £5 shares, the whole of which are allotted. 2,000 shares are considered as fully paid and upon the remaining shares the full amount has been called up. The calls paid amount to £17,835, leaving £2,165 unpaid.

African Direct Telegraph Company, Limited.—The statutory return of this company, made up to the 22nd April, was filed on the 29th April. The nominal capital is £300,000 in £10 shares. 22,500 shares have been taken up and the full amount has been paid thereon.

International Cable Company, Limited.—The statutory return of this company was made up and filed on the 3rd ult. The nominal capital is £1,000,000 in £10 shares, but the only shares taken up are the seven subscribed for by the signatories to the memorandum and articles of association, and upon these no call has yet been made.

CITY NOTES, REPORTS, MEETINGS, &c.

Australasian Electric Light, Power, and Storage Company, Limited.

THE fourth ordinary general meeting of this company was held on Friday last at the offices, 41, Coleman Street, Mr. Philip Falk presiding.

The Secretary (Mr. J. H. Duncan) having read the notice convening the meeting,

The Chairman, in moving the adoption of the report, said that his colleagues, as well as himself, confessed that they were disheartened and dissatisfied with the result of the working for the last twelve months. But they had reduced every possible expenditure on this side as well as in the colony, and, as they would see from the report for the last six months, the loss on their working had really been comparatively infinitesimal—namely, £111. The directors, however, had fully made up their minds that next time they met they would be able to show that, by having cut down the expenditure at both ends, and by fostering to the utmost extent their business, they would be able to secure some small profit. As far as he could see he believed they were turning the corner, and had times in Australia been more prosperous they would have had more public support. They had been anxious to sub-let, so to speak, to companies on the other side their patents, and so on—which, by the way, had recently greatly improved in value—but owing to the very adverse circumstances in the colonies for the last few years they had been unable to get people to entertain any proposal in that direction. If they could only wait a little longer he felt satisfied that such a period would arrive, and they would take advantage of it. As to the cause of their not having made greater progress, he could assign a good many reasons; but among others he would mention that they commenced life with perhaps too great expectations; they went to a new field, where they expected to make a very handsome thing out of the enterprise. The expenses at both ends, and more especially in the colonies, were very large; the work they did was of a tentative kind and the opposition they had to meet with on both sides was very great. The unwholesome competition they had had to contend against had also absorbed a large amount of their legitimate capital. As they were aware, the electric light companies here had suffered a good deal, and this circumstance had produced an unfavourable impression in the colonies, where there was a strong disinclination to be associated with anything that was not thoroughly established. The directors, however, in these circumstances had done all they could, and they would be encouraged to continue if they had the shareholders' approval. When times were prosperous among individuals there was a good deal of lavish expenditure, but when bad times came they had to curtail expenditure wherever it was possible. A similar experience had befallen this company, but it was utterly impossible unless they had had the power of divining the future that they could have acted differently. (A Shareholder: You were told to terminate the company.) That matter had been before them often enough. They had had work in hand which they were under the impression would secure them sufficient profit to enable them to pay their way and leave something for the proprietors. Unfortunately, however, in that expectation they had been disappointed, but that did not say that better times were not in store for them. If figures showed anything at all, they demonstrated beyond any doubt that they were now on the high road, at all events, to an

improved state of things. They were partners in the Australian Electric Company, Melbourne, in which this company held 18,000 shares. That company had already completed their lighting stations, and were beginning to pay, and the Australasian Company would participate in their prosperity so far as regarded dividend. By the amalgamation with that company the Australasian Company had got rid of a formidable opponent. They had followed the advice of the committee of investigation that was appointed last year, and had reduced expenditure in every possible way. One of the members of the committee was Mr. Van Tromp, who had joined the board, and from whose assistance they had derived very great benefit. They had given that gentleman every opportunity to go into the affairs of the company. It was expected that if the proposed arrangement with the Edison Company were carried out, Major Flood Page would join the board, and he thought that would prove advantageous to them. The chairman then concluded by moving the adoption of the report and accounts.

Mr. Van Tromp, in seconding the motion, stated that he had joined the board under the conviction that very great mistakes had been made in the management, and that there had been a good deal of expenditure which need not have been incurred. But he did not come on the board with any impression that any member of it had done anything that was discreditable or dishonourable, and that opinion subsequent enquiries had confirmed. They thought that in carrying out the arrangement with the Edison Company they would, as it were, put on the crowning arch to the building. He would not advise any shareholder, even if he were offered 20s. a share with a liability equal to £1 on his shares—he would not advise him to sell. That was his view of the condition of the company. They confidently believed that they would be able to make the company a dividend-paying concern.

Messrs. Kisch, Morrison, and Pearson criticised favourably the policy of the directors, and the report was unanimously adopted.

Mr. Peek moved, and Mr. Morrison seconded, a resolution re-electing the whole of the directors, which was unanimously approved.

The Chairman, in returning thanks, assured the meeting that the board would do everything in its power to merit this renewal of confidence.

The auditors, Messrs. Deloitte, Dever, Griffith & Co., were re-elected, at a remuneration of twenty guineas.

An extraordinary general meeting followed.

The Chairman moved the first resolution, approving and ratifying an indenture between the Edison Electric Light Company, of the first part, Mr. Thomas Alva Edison, of Menlo Park, New Jersey, U.S., of the second part, and the Australasian Electric Light Company, of the third part.

Mr. J. J. Cater seconded the motion.

A shareholder asked for an explanation of the purport and advantages of the agreement referred to.

Mr. Duncan explained the main points of the amalgamation agreement.

On the motion of the Chairman, seconded by Mr. Cater, formal resolutions following upon the foregoing were put and carried.

The meeting then terminated in the usual manner.

The Consolidated Telephone Construction and Maintenance Company, Limited.

UNDER the presidency of Mr. C. L. W. Fitzgerald, the 5th ordinary general meeting of this company took place at Cannon Street Hotel, on Thursday last, 10th inst.

The secretary (Mr. Charles Curtoys) having read the notice convening the meeting, and the minutes of the 4th ordinary general meeting,

The Chairman (after the shareholders had agreed to take the report as read) said:—I hope I may be permitted to congratulate the shareholders on the improved aspect of the affairs of the company. When I look back two years, and consider the position that the company was in then, how really hopeless everything seemed, and really, as we all know, at that time, no money in the bank, debts everywhere; then when we came to examine this balance sheet in comparison with that of 1884, we have, I think, really the greatest cause for congratulation. Looking back to 1884, I see the gross profits for that year were £5,600, and of that £5,000 was absolutely compromised to the United. Therefore, the manufacturing profits for that year were only £600. This year you see the profits on manufacturing are £11,438. That item would be nearly £1,000 larger, but for a question which arose at the last moment on the part of the United's auditors, as to the price of certain instruments. I believe the United's Board is sitting to decide that very question just now, and I believe that question will be decided in our favour. We propose that that £1,000 should be written off against the goodwill and patent rights. The next point I think I should call your attention to is, the note as to the interest and dividends accrued on the holdings of the subsidiary companies. We have taken no credit for that, though I think already there is something like £1,400 due, the greater part of which will be paid by Australia, and the Edison-Gower-Bell will also pay part of that interest. That is a matter of considerable importance to us, because we are looking in the future to get dividends out of our subsidiary companies. Further, gentlemen, in the balance sheet you will find "plant and machinery" £3,097. You see we have written off a considerable sum off our machinery, but we have got now in the factory some more improved instruments from America. Now, our machinery is in an absolutely better condition than it was last year, and only at the same cost. Our stock of instruments—we have £3,303 worth. When I read to you an extract from a letter from one of the firms of Germany, which is perhaps at the tip-top of the electrical world—when they write to us on some of our samples which we submitted as follows:—"The tests which have been made with your instruments prove that they may be classed among the very best which have ever come under our notice"—and when I tell you that our stock is all of that character, you may imagine that I look with some degree of satisfaction on that communication. Now, gentlemen, there is the item of £11,590 owing by the subsidiary companies. That item includes a large sum owing us by the River Plate Telephone Company—£9,500. You will have seen from the report, that we have at last made terms of amalgamation with the opposition, and that to me is a very gratifying thing, because throughout this fighting the Consolidated has had to support the River Plate in cash, instruments, and stores, through thick and thin. On the other side of the balance sheet, I can assure you we have done everything possible to reduce the expenditure. I think you will find every item there shows a reduction on last year; but there are four items here which I should like to call attention to, which items I do not think will occur again next year. One is travelling expenses, £194; then there are expenses in connection with the Australian law suit, £167; commission on sale of River Plate debentures, £280; and accountants' special charges for preparing balance sheet, £40—in round numbers a total of £700. I only hope that in the next balance sheet those items will not be there; consequently, instead of the charges being £3,695, they will be under £3,000. The gross profit for the year amounts to £13,475. That profit has been collected from, I may say, all parts of the world; from some of our colonies; and I was extremely gratified, I may say, in getting two orders from America. I did not expect, I must confess, that I should go into the enemy's country in that way, but we *did*; and I hope we may get some more orders. Our business is slowly and steadily, but *surely*, extending, and I attribute that to the absolute goodness of our manufactures. I could show you heaps of testimonials on that head; and in addition to that we are really supplying the subsidiary countries in England with certain articles, magneto bells, and so on, which all means profit to us. We have started agencies in Madrid, Cadiz, and Naples, and I think I may say that these agencies will become very valuable outlets for our business. But I find the prices abroad too dear. Within the last six weeks the Government of Spain have asked if we would undertake to erect an exchange for them; a fact which looks as if they were recognising the superiority of our instruments. We have obtained, also, an absolute return of income tax. The next item is the law suit, which Col. Gouraud has started against the company, for his fees. We are advised that we have a very good defence indeed to that action up to within a very small portion of the claim which Colonel Gouraud brings against us. You will observe that the board ask you to permit us to assist the Edison-Gower-Bell Telephone Company in protecting the patent rights owned by that company in Belgium. This is a very important question. I cannot tell you how much the sum of money involved in it is. When I tell you that our greatest opponents, the manufacturing company over there, are turning out large numbers of instruments, every one of them being an infringement of the patent held by the Gower-Bell Telephone Company, you will realise that it is important that we should stop this infringement if possible. We shall not spend one penny more than is necessary, and shall only go into this matter if we feel our ground is very safe. Law is a very uncertain thing; but this particular Edison patent is the master patent in England and also in America. We are going to propose a resolution that you allow us to assist the Edison-Gower-Bell Telephone Company, but it will be on the understanding that we get half of whatever is made out of the transaction—bear half the cost, and take half the profit. Now, I think, I am coming to the most satisfactory part of the whole report—the amalgamation of the River Plate Telephone Company. I think I had better say as little as possible on that point, because we have only signed a preliminary agreement, therefore it is possible that I might say something which will do us no good. The next point which ought to be of equal benefit to the shareholders is the increased number of subscribers, and the rental of the subsidiary companies. You will find we (the Consolidated) hold £66,000 in debenture and preference shares of these three companies. Now, they are beginning to return us money, and if I mistake not this year will return us more money, especially if this River Plate amalgamation takes place. Indeed it is possible that in the future the large sum which stands here, which is even taken as nothing—£22,258—of those shares of the ordinary share capital of the subsidiary companies, may return to us some income. In Austria we shall have some return in course of time, and also in the River Plate, if the amalgamation takes place. If you will remember for a moment what that means—£66,000 of debentures—even if we only get 5 per cent. on that, the whole of our fixed charges would be paid by that return, so that we may divide every penny of profit. I have always had my eye upon the subsidiary companies, because I am sure they mean large returns. People do come for the telephone in a most marvellous way. If I return to the Austria report, I find that 18 months ago we had 600 subscribers only; we have now 1,373; and I may say that they are coming almost too rapidly for us in

Austria, for we want capital to carry out the work. While I am on that point I would say that the Board of the Austrian Company propose issuing some 6 per cent. preference shares. If the shareholders of the Consolidated wish to assist the Austrian Company, and themselves, they will assist that Austrian board by taking some of these shares. As far as I am concerned, I and my father have already a considerable stake in the Austrian Company, and I am thinking of putting some more money into it. I think it is as good a thing as I have come across. I will now read the first resolution I have to propose: "That the statement of accounts and balance sheet, and the report of the directors, as now submitted to the meeting, be received and adopted; and that a final dividend of 2½ per cent. be paid, making, with the interim dividend previously paid, 5 per cent. for the year ending 31st March, 1886."

Sir Alexander Armstrong seconded.

Mr. Flenk: What is the probable cost of this litigation, and the probable result of that cost?

The Chairman: We have gone into this question considerably before bringing it under your notice. So far as we know, we *think* the probable cost will be about £2,000. The probable profit would mean many thousands of pounds, if we are successful. The Belgian infringers would have to pay us for the infringements in the past, if we are successful.

Mr. Flenk: Do I understand that our total contribution to the cost would be £2,000?

The Chairman: No, £1,000. The Edison-Gower-Bell Company of Europe would pay £1,000.

A Shareholder: May I ask whether our opponents in Belgium are a rich company; and whether we are likely to recover—whether they are worth powder and shot?—

The Chairman: I only wish we were as rich.

The Chairman then put the resolution for the adoption of the report, &c., which was agreed to.

The following resolution was then submitted by the chairman, seconded also by Sir Alexander Armstrong, and adopted: "That the directors be authorised to take such steps as they think desirable in connection with the Edison-Gower-Bell Company of Europe, for the protection of their patent rights in Belgium."

On the motion of the Chairman, seconded by Mr. John Taylor (one of the board), the following members of the board, who retired by rotation, were re-elected: Sir Alexander Armstrong, and Messrs. A. H. Baker and H. Grëwing.

The auditors, Messrs. J. E. Griffiths and A. E. Green, having been duly proposed and seconded, were also re-elected.

Mr. Lloyd then proposed a vote of thanks to the chairman and the board, and referred to the admirable progress made by the company within the last two years. When they looked back, he thought they would be convinced that their success was not due to a fluke, but was really due to good management; and he thought that, under the circumstances, the board deserved their warmest thanks. The chairman had said that if things went on smoothly their dividends from the subsidiary companies would cover the fixed expenses of the Consolidated, and that, he thought, was very satisfactory. The organisation of their factory was such that they did not need to lock up any capital for working purposes, because payment followed rapidly on the work done.

The Chairman briefly replied, and the proceedings closed.

London Platino-Brazilian Telegraph Company, Limited.—The balance sheet and accounts for the past financial year are stated to have been made up on the same principle as those previously laid before the shareholders. The net revenue of the year, after providing for debenture interest and income tax, is £4,087 18s. 5d., and £1,068 4s. 11d. is brought in from the preceding year's account, making a total of £5,156 3s. 4d. to the credit of revenue account. The interim dividend of 1s. per share, paid on the 17th November, 1885, absorbed £1,917 8s., leaving therefore to be dealt with £3,238 15s. 4d., from which the directors propose to appropriate £150 in further reduction of the item of expenses of issue of the six per cent. debentures, and £1,917 8s. in payment of a final dividend of 1s. per share, making, with the interim dividend already paid, a distribution at the rate of 1 per cent. per annum; leaving a balance of £1,171 7s. 4d. to be carried forward against the amount due by the Uruguay Government. It is stated that the competition for South American traffic with the cables of the North Atlantic and of the West Coast of America Companies has continued during the past year, and has seriously diminished the revenue of the Western and Brazilian Company, in which this company is so largely interested.

Cable Rate Reductions.—Rates to come into force on July 1st.—Important reductions of tariff are to be made by the Eastern Telegraph Company not only to all countries in Europe, but also to India, Siam, Cochin-China, China, Manila, Japan, Australia, Tasmania, and New Zealand.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending June 11th were £2,194, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending June 11th were £2,756.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1885.

5376. "Improvements in and relating to electric motors for the propulsion of boats and other purposes." A. ECKENZAUN. Dated May 1. 8d. The object of the present invention is to provide means whereby the direction of rotation of an electric motor or motors can be reversed, and at the same time to effect such reversal only at the moment when no current is passing through the armature or armatures of the propelling apparatus. The inventor effects the reversal or the displacement of the brushes relatively to the commutator by means of parallel bars capable of sliding to and fro in or on fixed slides. Upon these bars he places the brushes which will approach to or recede from the commutator according to the movement of the bars which are in plan at right angles to the axis of the armature. In order to prevent the possibility of an untimely reversal which often occurs in a hurry during an excitement on board an electric boat, car, or other vehicle propelled by electricity, or on anything driven by electric motors, he connects the said sliding bar or bars by suitable means with the lever of a switch which makes and breaks the main circuit between the motor and the generator. Either the switch lever is provided with an oblong hole, or the reversing bar or some intermediate link can be made to have sufficient back lash or freedom of movement so that the contact on the switch is broken whilst the brushes of the motor are at rest. By moving the switch handle still further the brushes are reversed, and finally by putting the lever to the end of its course contact is made in the switch to allow the current to flow when the rotation of the armature is the opposite of what it was with the switch lever in its original position. The return movement will of course bring the mechanism back to the first condition. The back lash of the mechanism and an intermediate spring or its equivalent determine the relative motion of the switch handle and the brushes.

6118. "An improved electrical system of sending and receiving signals, principally for domestic use, and apparatus to be used in connection therewith." H. P. F. JENSEN, B. W. WEBB, and J. JENSEN. Dated May 19. 8d. The principle of the invention is to enable a person sending a signal or call by the ordinary means applied for electric bells to receive back a confirmation signal, for instance, if one of the apparatus was fitted in room A and a similar one in room B, by turning the handle of apparatus in room A the apparatus in room B would keep on ringing or indicating until the handle of apparatus in room B was turned up thereby electrically replacing the handle on apparatus in room A.

6608. "Electrical indicator for alarms and other purposes." E. W. LANCASTER. Dated June 1. 8d. The inventor employs one or a pair of electro magnets at the ends or longitudinally of which he suspends by means of a spring a soft iron armature provided with a catch or bevelled stop piece projecting from it above, or in any suitable position about the armature is pivoted a disc shaped arm having connected to it at any angle a short crank which crank rests against the catch or stop piece on the armature and holds up the arm. The working is simply that of a current of electricity passing or circulating through the coils of the electro-magnet causes the armature to be attracted towards the said electro-magnets releasing the crank from the catch or stop piece and allowing the arm to fall to its lowest position indicating that the circuit had been completed. To replace the arm and crank to their positions behind the catch or stop piece a small rod is provided which slides behind the cranks having pins of suitable length to move the crank; on the rod being pressed lengthwise the crank is replaced as required.

7222. "Improvements in the manufacture of carbon for electric lamps and other electrical apparatus." J. Y. JOHNSON. (Communicated from abroad by La Société A. Chertemps et Cie., of Paris.) Dated June 13. 4d. According to this invention fluoride of baron and its derivatives are employed for dehydrating organic matter containing the elements of water in chemical combination with the object of obtaining carbon suitable for use in the construction of electrical apparatus, and in the manufacture of incandescent electric lamps in particular.

7583. "Improvements in means for signalling or telegraphing between railway trains, or between trains and stations, by induction." T. J. HANDFORD. (Communicated from abroad by T. A. Edison.) Dated June 22. 8d. Relates to the apparatus described in the number of the REVIEW for April 23rd.

7700. "Improvements in electro magnets and induction coils." C. D. ABEL. (Communicated from abroad by M. Lahaussois, of France.) Dated June 24. 8d. The soft iron core of an electro magnet or induction coil is, according to the present invention, constructed of such a configuration as to correspond with the aggregate form assumed by the gyrating particles of a whirlpool, &c., that is to say, it is made in the form approximating to that of two cones or conoids meeting at their apices, the poles of the core being consequently of considerably larger diameter than its middle.

8733. "Improvements in galvanic batteries." W. H. QUARTERMAN. Dated July 20. 8d. The object of the invention is to simplify the charging and discharging of galvanic batteries, so that they may be easily used for domestic lighting by persons having no previous knowledge of electricity, and enable them to

charge and discharge the fluid, or fluids, in a quick and simple manner, without requiring the removal of covers or interference with connections. The ducts for conveying the fluid to the inner system of porous cells are formed in or under the bottom of the outer system of cells, and are carried up vertically at one end to the height required for the fluid to rise in the porous cells, and finished with a funnel shaped mouth, so that without removing the cover of the battery (to which the electrodes are fixed) the person charging the battery can see when the required quantity of fluid is poured in, or several batteries can be charged from reservoirs from which pipes with taps are arranged to discharge into the mouths of the ducts. The bottom of the said outer system of cells having the said ducts has taper holes leading into the ducts for charging the porous cells, and these holes are ground perfectly true and round, to one standard size. The outer system of cells has a hole at the bottom corner of each division to allow the fluid to flow throughout from cell to cell, and is charged by a duct at the same end as that from which the porous cells are charged. To discharge the battery a tap is provided for each fluid, one tap communicating with the ducts at the bottom of the outer cells, and the other tap with the outer cells themselves.

1886.

2080. "Improvements in electric switches." A. BERNSTEIN. Dated February 12. 8d. Relates to the switch described in the number of the REVIEW for April 2nd.

2282. "Improvements in apparatus for separating magnetic from non-magnetic substances." H. H. LAKE. (Communicated from abroad by H. Kessler, of Germany.) Dated February 16. 6d. Consists of an endless chain provided with a number of magnetic pins, which pass through and stir up the mass of material being acted on.

2317. "Improvements in electrical switches." C. BROWETT. Dated February 17. 8d. Relates to an improved form of electrical switch by which an electrical circuit may be opened or closed in a simple manner, by means of a cord, which may be pulled by hand in the same way as an ordinary bell-pull, the mechanism being so arranged that on the cord being pulled and released, the circuit is closed, if previously opened, and opened if previously closed.

2348. "Improvements in the manufacture of telegraph poles, columns, pillars, flag staffs, signal posts for railways, lamp posts, fence posts, and other posts; rolls or rollers for various purposes; chimneys, pipes for conveying liquids or gases, and other like tubular articles; railway and tramway sleepers, door steps, lintels, window sills, building blocks; and tanks, casks, and drums for containing liquid, semi-liquid and solid matters; and arms or insulator bars for telegraph poles and telegraph insulators; and in the method of and means or appliances for steadying telegraph poles and other poles and posts." D. WILSON. Dated February 17. 8d. Consists in part of the improvements on the apparatus described in a provisional specification filed by the inventor on May 15th, A.D. 1885, in application for Letters Patent, No. 5990, and the said improvements consist in using cement alone in place of concrete in the manufactures described in the said specification.

2456. "Improvements in holders for incandescent electric lamps." J. LEE. Dated February 19. 6d. The holder is constructed with a pair of arms which grip the terminal loops of the lamp and so give the greatest possible contact and security from disconnection.

2652. "Improvements in speaking telephone transmitters." W. C. TURNBULL. Dated February 23. 8d. The object of this invention is to provide a microphonic telephone transmitter having a large capacity for transmitting electrical undulations corresponding with the waves produced by sound, and at the same time, one which will not require special adjustment, but will always remain in good working condition.

2783. "Improvements in the construction of electro-motors for the propulsion of tramcars, electric locomotives, vehicles, and other purposes." A. J. JARMAN. Dated February 26. 8d. The object of the invention is to permit a suitably-constructed electro-motor or motors of any type, size or kind in which the critical speed of the motor or motors is higher than the vehicle or machinery to be driven to transmit power with as little friction as possible, and to enable a reverse motion of such motor, vehicle, or machinery, without the employment of any of the usual reversing gear, such as bevil wheels, mitre gear, large or small crown racks, clutches, and the like, and without the well-known double brush system as applied to one collector or commutator of a single armature. The inventor fixes two armatures upon one axle or spindle and employs two sets of field magnets fitted to one common base plate, and the tops of the field magnets fitted to one common yoke, thus forming a compound electro-motor. A toothed or other suitable wheel is fitted upon any convenient part of the axle or spindle for communicating power to other wheels or machinery required to be set in motion. Each armature has a collector or commutator of its own, and a pair of conducting wire brushes or plates. These brushes or plates are so arranged that one armature can revolve in one direction when a current of electricity is allowed to circulate through it and its field magnets, and the brushes of the other armature are so arranged that it may revolve in the opposite direction when a current of electricity is allowed to circulate through it and its field magnets. The reverse motions are obtained by the brushes or plates being lifted off the collector or commutator of one armature by any suitable mechanical contrivance, while the brushes or plates of the other armature are placed upon its commutator or collector by the same mechanical contrivance.

CORRESPONDENCE.

Filaments of Deposited Carbon.

Our attention has been called to the recently published specification of Mr. Alexander Bernstein's patent (No. 13,036, of 1885), for "Improvements in the manufacture of carbons for incandescent lamps." The patented process would appear to consist in the decomposition of a carbon compound by the electric arc, with a resulting deposition of hard and dense carbon upon one of the electrodes. The patent also includes the use of a movable electrode, which being drawn away from the fixed electrode as the carbon is deposited, preserves the length of the arc constant, and permits of the deposition of uniform filaments of any desired length.

On the 10th November, 1882, a patent (No. 5,373, of 1882), was taken out by ourselves in conjunction with Mr. J. M. Boullon for "Improvements in electric lamps or lighting apparatus, and in the manufacture of light-emitting conductors for the same," in the specification of which we describe a process for the preparation of carbon filaments by the decomposition of a carbon compound by electricity and the resulting deposition of carbon upon one of the electrodes. We say :—"We take a suitable gas or vapour and subject it, as hereinafter described, to the action of the electric spark, which may be produced by any suitable generator of high-tension electricity. For this purpose we provide a globular, or other suitably shaped vessel of glass, in which we insert metallic conductors or electrodes. . . . . In some cases carbonaceous gas or vapour, such as marsh gas or coal gas, is introduced into the glass vessel, and is decomposed by the passage of electric sparks through the same. A slight deposit of carbon takes place upon the end of one of the electrodes, which deposit is gradually built up by means of a rapid succession or continuous flow of sparks, and a bridge of carbon is thus formed, so that the space separating the said metallic electrodes, between which the spark passes, is completely arched over. This bridge forms the filament to be used as the light-emitting conductor."

The advantage of using a movable electrode, for the preservation of a uniform arc and the production of filaments of uniform substance, and of greater length than it would be possible to prepare with fixed electrodes, early presented itself to us, and we therefore say in our specification :—"We find it advantageous to make the said filaments in a separate vessel, and to insert them and their electrodes afterwards within the lamp or lamps of which they are to form a part. In preparing our filaments to be used in this manner, we pass the electric sparks between electrodes of highly purified graphite. . . . . The filaments so formed we attach to electrodes in any convenient manner, and insert in . . . . vessels of glass in the usual way." We have in our possession at the present time a spiral filament 9 inches long, made by us three years ago with the aid of a movable electrode; and we may say that, except in our earliest experiments, all our filaments have been made in this way.

The apparatus figured by Mr. Bernstein in his specification would seem only capable of producing straight filaments, whereas the apparatus we have ourselves been in the habit of using will produce filaments of any degree of complexity of figure.

Alfred W. Soward.
I. Probert.

Telephone Matters in America.

The United States suit against the Bell telephone patent is, in my opinion, likely to remain on the calendar of the court an untried case for years to come—or just so long as the astute counsel of the Bell Company may please to keep it there. In a former letter I wrote that the Bell Company would demur to the jurisdiction of the court, and it has now done so. June 1st was set down by the court for the hearing of the case; the Bell Company did not file any answer to the bill of complaint, but simply demurred to the jurisdiction of the court, and no time has been set for hearing the argument for the demurrer, and should the court overrule the demurrer, the Bell Company will, I think, take an appeal to the United States Circuit Court, and in case an adverse decision thereon, then to the United States Supreme Court, where it may be heard early in 1887.

The suit brought by the Bell Company against the National Telephone Company in New Orleans which was argued in February last, has been decided in favour of the Bell Company—just as it should be—for the simple reason that the instruments used by the National Company were simply Bell receivers and Edison transmitters; the principal point of defence was that Bell was not the first inventor of the telephone, and that his patent therefore was void. The fact is Bell's counsel are too strong for any counsel yet brought against them, and I do not think any counsel can be brought who will be able to contend *scientifically* against them. Bell will be considered by his admirers to be the inventor of the telephone, until an instrument is made according to the description given by Bourseul of his telephone in 1854; and I am happy to say that I have unearthed the *original publication* signed "*C. Bourseul*," *Paris*, 1854, preceded by remarks of the editor of the paper. The references about M. Bourseul by the late M. Du Moncel and myself are not correct.

I have had made an instrument in exact conformity with Bourseul's description, and it transmits and repeats articulate speech perfectly well.

Count Du Moncel published in *La Lumière Electrique*, of November 24th, 1883, over his own signature, "If we agree to call the true inventor that man who is the first to conceive clearly a new idea, and who tells us how this idea can be carried into practice, then the telephone was invented in 1854 by Charles Bourseul, a Frenchman, at that time a soldier in the French army in Africa."

W. C. Barney.

Washington, *June 4th*, 1886.

Schanschieff's Battery.

A criticism such as that by "A Maker of Primary Batteries" in your last issue is welcome to every honest inventor, and I have to thank your correspondent for his remarks. Faults honestly pointed out help an inventor, who is thereby spurred on to attain perfection, if possible.

I will deal with the two points raised by "A Maker of Primary Batteries" in their inverse order:—

1st. Deterioration of terminals and connections. If my exciting solution be spilt over the terminals in ordinary use the result is that the metal becomes amalgamated with mercury. To obviate this I now employ two methods. In some forms of the battery (hermetic and so on) I use iron terminals; in the batteries with open cells I use platinised terminals and connecting strips, completing the protection by varnishing when connected up.

2nd. The cost of work. In order to prove the working cost of my batteries, I will compare it with that of bichromate cells. The best form of the latter is said to be that in which chromic acid is used. Taking the wholesale price of this as 6d. per lb., the gallon of solution will cost about 1s. 6d. The price of my exciting liquid wholesale is 4s. 6d. per gallon, from the cost of which has to be deducted the value of the residue which I repurchase at 1s. 4d. per lb. According to the degree to which the liquid is worked out so will be the return from the residue deposited—ordinarily from 26 to 30 ozs. per gallon—value from 2s. 2d. to 2s. 6d.

In order to make my calculations perfectly plain and above board, I will take the figures given by M. Criquebeuf in the diagram prepared in the laboratory of M. Hospitalier, to which you refer in another part of your last number. The battery he tested was one of eight cells, each containing three-quarters of a pint of my exciting liquid, or six pints in all; this discharged a current of 0·8 ampère under a pressure of 11·25 volts at the beginning, and of 9 volts after eight hours' consecutive work; the mean E.M.F. I will take as 10·125 volts; the cost of the liquid (six pints at 2s. 4d. per gallon) being 1s. 9d.

A similar battery charged with chromic acid solution will develop 13·5 volts and give 1 ampère for not more than two hours, the cost of the charge at 1s. 6d. per gallon being 1s. 1½d.

I append a table showing these results:—

Battery.	Volts.	Amp.	Hours.	Total work in watts.	Cost of charge.	Cost per watt.	Cost per C.P.
					s. d.	d.	d.
Chromic acid...	13·5	1	2	27	1 1½	0·5	1·5
Schanschieff's	10·125	0·8	8	64·8	1 9	0·323	0·975

I have seen the working cost of bi-chromate batteries given by makers at one farthing per hour per lamp C.P. not stated. I would it were possible. Very probably a battery of large dimensions may work more economically than is shown above, but on the other hand I believe that under the same conditions my battery will show still better. My invention being so new, I have not had time or opportunity to have a battery on a large scale authoritatively tested: my own figures I prefer not to quote, for inventors are proverbially sanguine in judging their inventions. In the data of work of chromic acid I have calculated approximately, rather over-stating its capabilities, I believe, whilst as regards my battery I give the exact figures furnished by a high authority under a test which I personally consider severe.

A. Schanschieff.

June 15th, 1886.

[We presume Mr. Schanschieff, in giving the price of his liquid as 2s. 4d. per gallon, has made allowance for the value of the residue, as in the previous paragraph he quotes 4s. 6d.—EDS. ELEC. REV.]

A Hint to Correspondents.

I notice in this week's REVIEW a protest by a correspondent signing himself "Telephonist," against the adoption of his *nom de plume* by another writer, whose opinions happen to be quite in opposition to his own.

May I take this opportunity of suggesting to correspondents that it would be wiser for them in most cases to write always over their own name.

I do not say that circumstances may not arise under which, while it would be for the general advantage that a certain letter should be written or certain facts made known, it would be unfair to the writer that his name should be disclosed; but I think in a scientific paper such cases would be rare; and meanwhile the *nom de plume* is too often made to cover either spiteful attack or inaccurate statement.

I think that in the majority of cases where letters are written for insertion in the columns of a scientific journal, the fact that the writer would not wish his name to appear, should be a sufficient reason for not writing.

If the fact that everyone will know who is responsible for certain statements, or who is the writer of certain paragraphs, causes writers to be more careful as to what they write, the result can hardly be but beneficial; and on the other hand, if a man has anything to say worth printing, surely it should be to his advantage to get the credit of it himself.

Sydney F. Walker.

Cardiff, *June 14th*, 1886.